ASEM SMEs Eco-Innovation Center

ASEIC-GGGI Pilot Project Report in Cambodia (2011)

GREENING LOCAL COMMUNITIES THROUGH APPROPRIATE TECHNOLOGY

SPECIAL FOCUS: ECO-INNOVATION IN ACTION, NURTURING LOCAL OPPORTUNITIES WITH SOLAR COOKERS

Global Green Growth Institute

SMBA Small & Medium Business Administration

SBC Small & medium Business Corporation

HANBAT NATIONAL UNIVERSITY SINCE 1927

ASEM SMEs Eco Innovation Center (ASEIC)

The ASEM SMEs Eco-Innovation Center (ASEIC) aims to promote eco-innovation for small and medium-sized enterprises (SMEs) in Asia and Europe. Its establishment was endorsed by the leaders of ASEM member countries at the 8th ASEM Summit in Brussels, Belgium. ASEIC seeks to serve as an international platform where growing environmental regulations and eco-innovation practices are shared and new opportunities are created. ASEIC is currently funded by the Small and Medium Business Administration (SMBA) of the Republic of Korea and its office is located in Seoul.

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EXECUTIVE SUMMARY

Only six percent of Cambodia's rural population has access to electricity; most of this electricity is from village grids often powered by inefficient diesel generators (World Bank 2009). Most people at the bottom of the economic pyramid rely heavily on firewood for cooking, which poses serious environmental and health-related threats. Moreover, improper waste disposal has caused widespread sanitation-related diseases.

This pilot project seeks to address these problems through the adoption and demonstration of appropriate technologies. Specifically, the initiative involved manufacturing twenty solar cookers and constructing twenty mini waste incinerators, which are especially designed to suit the local conditions of the community around Phnom Penh. The project is envisaged to create local business opportunities by commercializing the technologies while reducing health and environmental risks to the local residents. The ASEM SMEs Eco-Innovation Center (ASEIC), which aims to promote eco-innovation for small- and medium-sized enterprises (SMEs) in Asia and Europe, is the implementing agency of the project. The funds are appropriated by the Small and Medium Business Administration (SMBA) of the Republic of Korea via the Small and Medium Business Corporation (SBC). The project is linked to the country program of the Global Green Growth Institute (GGGI) for Cambodia.

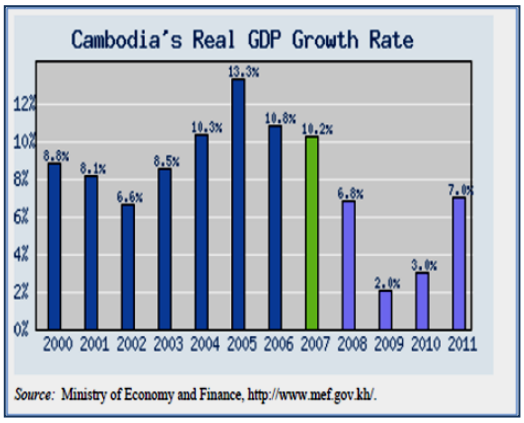
The target consumers for the solar cooker are individuals from lower income brackets in the rural areas in Cambodia, where 79.9 percent of the households live, according to the Cambodia Socio Economic Survey (2004). Since the process of encouraging the villagers to adopt the technology in their daily lives requires enormous efforts, the project capitalized on the bottom-up approach by utilizing the Institute of Sustainable Agriculture and Community Development (ISAC) to build a strong bond with the local community. This strategy underscores the importance of gaining a deeper understanding of the culture and the local environment in order to build mutual trust, which has proven to be crucial for the success of project. To foster sustainability, ASEIC and its partners intend to develop the capacity of Cambodians in commercializing technologies by helping them set up their own micro or small social enterprises, create a market for the solar cooker and eventually achieve financial independence in the long term. Against this backdrop, several modalities to supply the technology at reasonable prices are examined and each method is scrutinized based on the degree to which it enables technology to efficiently reach the poorest and largest socioeconomic group. Once a successful distribution model has been established, it could be applied elsewhere in the region of Cambodia.

I. INTRODUCTION

A. Country Profile

The Kingdom of Cambodia is a constitutional monarchy, which shares its borders with Laos, Vietnam, and Thailand. It has a total landmass of 181,035 km^2 and a population of 15 million. Its capital city is Phnom Penh and the two other main cities are Siem Reap and Sihanoukville. Cambodia's GNI per capita in 2010 was USD 760, ranking only 185th among 215 countries (World Bank 2011). However, its GDP growth rate remains relatively high, reaching seven percent in 2011 following a drastic drop in 2009 and 2010. In 2009, Cambodia had 29,000 SMEs, employing less than 50 employees. Eighty percent of the enterprises belong to the food, beverage, and cigarette manufacturing industry.

[Table 1] GDP Growth of Cambodia



Source: Ministry of Economy and Finance, http://www.mef.gov.kh/.

[Table 2] Number of SMEs in Cambodia

Enterprise type	1998	1999	2000	2001	2002	2003	2004	2005
Food, beverage and tobacco	18,590	19,147	20,152	21,871	21,568	20,869	22,712	23,343
Textile wearing apparel leather	310	396	366	2382	1,417	1,406	1,672	1,662
Wood products including furniture	895	814	869	141	13	13	16	-
Paper products printing publishing	26	23	24	23	15	21	25	31
Chemicals petroleum coal plastics	55	67	297	277	275	96	120	153
Non-metallic mineral products	811	777	666	721	757	681	680	718
Fabricated metal products	1,375	1,647	1,824	1,454	1,899	1,850	2,239	2,222
Other manufacturing	2,035	1,356	1,208	1,286	976	1,049	667	618
Total	24,097	24,227	25,406	28,155	26,920	25,985	28,131	28,747

Notes: SMEs in this data set are defined as employing up to 50 people. There are very few enterprises that employ between 50 and 100 people in Cambodia, so not including this group still provides a reasonable estimation of enterprises with fewer than 100 employees.

Source: Cambodian Ministry of Industry Mines and Energy, *Cambodian National Institute of Statistics Yearbook 2006*

Cambodian residents primarily use firewood for cooking, thus resulting in severe health-related and environmental problems. Burning firewood gives off air pollutants that pose health risks, and the widespread cutting of trees to obtain wood leads to rapid deforestation.

Health risks are also posed by the spread of sanitation-related diseases as a result of improper waste disposal. More than ten million people died in Cambodia due to diseases related to poor sanitation. In economic terms, this loss is estimated at 4.5 billion dollars or approximately 7.2 percent of the national GDP (World Bank 2008).

Furthermore, Cambodia's conventional waste incinerator plant, mostly built by non-governmental organizations (NGOs), is found to lack proper roofing. It functions defectively during heavy rains when leaked rainwater causes the waste to rot, eventually producing a foul odor, and breeding pests and germs. Thus, the incinerator plant had to be removed and the need for a better waste incinerator became a pressing need.

B. Background of Appropriate Technology

To address the myriad of socioeconomic and technological problems confronting Third World countries in the mid-1960s, economist E.F. Schumacher introduced the concept of "intermediate technology" in his groundbreaking book, *Small is Beautiful* (1973). Utilizing intermediate technology involves the efficient use of local resources, and it also seeks to cater to the needs of the local people. Moreover, it ensures simplicity in product design and affordability in price. Intermediate technology has also been branded as "appropriate technology" or "alternative technology." However, "appropriate technology" has been the most widely used term because the word "appropriate" takes into account the unique needs of the local people.

In his thesis, *The Gandhian Approach to Swadeshi* or *Appropriate Technology: A Conceptualization in Terms of Basic Needs and Equity*, Bakker Hans claims that appropriate technology encompasses all types of technology that cater to the basic needs of the people at the bottom of the economic pyramid (Hans 1990). Meanwhile, the National Center for Appropriate Technology in America (NCAT) defines the term as: "devices or strategies that are appropriate for the applied environment in cost and size." Amid these definitions, appropriate technology is generally characterized by the following features:

1) The price must be affordable to the users.
2) It should utilize local resources.
3) It should generate jobs, tapping local labor and technology.
4) It is small in scale and simple in design.
5) Its use must be simple enough to be understood even by people who are not well-educated.
6) It should foster social collaboration and local development.
7) It should tap renewable energy sources.
8) It should easily adapt to changes in local environment.
9) It does not entail intellectual property rights, loyalties, custom taxes, etc.

Given these characteristics, appropriate technology corresponds to the harmonious relationship between nature and technology. In addition, the specialized application of appropriate technology makes it well-suited for one local area and inappropriate in another. Abudakar N. Abdullalli noted that its overarching aim is to help promote the welfare of the local people. Similarly, Peter Dunn stressed that appropriate technology must go smoothly with local culture and should thus preserve societal traditions.

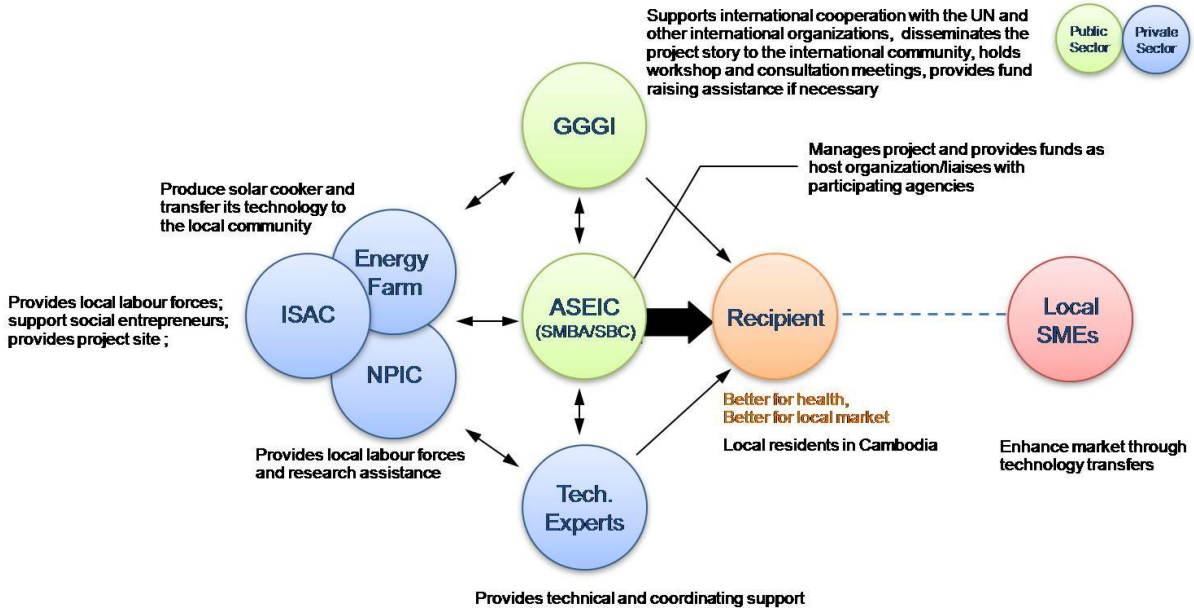
The definitions above render appropriate technology different from the conventional type of technology. However, it is not just technology alone. It is also a way of thinking: a philosophy that integrates economic growth and sustainability. It also fosters a responsible attitude on the use of technology. According to Dunn, appropriate technology is: "self-revolving, active and a perfect systematic approach to development. It is an approach to community development that is composed of knowledge, technology and the founding philosophy." Furthermore, appropriate technology is people-centered; it is a philosophy that prioritizes human progress rather than technological advancement alone. It incorporates an array of goals, processes, and actions that address basic human needs.

II. PROJECT DEVELOPMENT

A. Project Description

The project aims to prevent deforestation and promote proper waste management in Cambodia by introducing the use of solar cookers and mini incinerators. Specifically, the initiative involved setting up twenty solar cookers in Takeo, Cambodia and twenty mini-incinerators in the neighborhoods near Phnom Penh. The project is carried out by ASEIC in collaboration with the Center for Appropriate Technology of Hanbat National University and other important stakeholders who actually implemented the project on site in Cambodia, namely the Energy Farm Inc., the NPIC, and the ISAC School.

[Figure 1] Stakeholder dynamics



This project is also linked to the GGGI's Cambodia Green Growth Program, which is intended to develop the National Green Growth Master Plan (NGGMP) to assist Cambodia in achieving continued rapid economic development while preserving environmental integrity. GGGI's objective is to help Cambodia meet its goals of developing national economy, spurring job creation, and identifying new opportunities for economic growth. In doing so, GGGI's country program for Cambodia includes both the top-down and bottom-up approach, which entails establishing a green growth legal framework; tailoring specific policies; and scoping, analyzing, and implementing plans in forestry, small- and medium-sized business promotion, green job creation, and waste management (GGGI 2011).

B. Target Client

The project is located in Takeo, a region approximately 70 kilometers south of Phnom Penh. Based on the survey conducted by Energy Farm and ISAC involving 97 households, most of them use wood for cooking and they spend a significant amount of time obtaining it. Ninety percent of the households collect woods on their own and only 10 percent of them buy them. Half of the respondents admit that they suffer from health problems caused by the exhaust fumes from burning firewood, and many of them (69 percent) are willing to purchase solar cookers at a reasonable price.

Before the project was implemented, a survey was conducted to assess the feasibility of distributing solar cookers and constructing mini incinerators in Takeo. The survey questions and results are as follows:
1. Which of the following sources of fuel do you usually use for cooking? - Wood only (72.2%), Wood and gas (14.4%), Wood and charcoal (4.1%) 2. How do you collect wood? - Direct logging (89%), Buying (11%) 3. If you collect wood on your own, how often and how long does it take you to obtain wood? - The average is 5.5 times a month, 2.2 hours at a time. 4. Do you suffer from health problems due to the indoor exhaust fumes? - Yes (50%) 5. Are you willing to pay five dollars per month for 2 years to purchase a solar cooker? - Yes (69%)

C. Project Components

1. Solar Cooker

The project set up a working space for manufacturing solar cookers at ISAC in Takeo with the help of the 20-30 students. The production cost for a single solar cooker is estimated at USD 160, which is unaffordable for local residents in Cambodia given their income level. The various methods of distributing solar cookers will be examined in the chapter of Special Focus.

[Figure 2] Over 150 local residents including local government officials gathered together for the solar cooker demonstration event at the ISAC School in Takeo.

A2 MONDAY, NOVEMBER 28, 2011 BUSINESS FOCUS Development

Appropriate tech more than foreign aid tool

Solar cooker project in Cambodia shows it doesn't take cutting edge technology to change the lives of the poor

Analysis

"If I am given an opportunity, I want to run a small company selling the cooker," Narorn Dourg, a 22-year-old Cambodian, said.

[Figure 3] *The Korea Times* featured the solar cooker project in Cambodia, which shows that it doesn't take cutting edge technology to change the lives of the poor.

The amount of carbon dioxide emitted by the combustion of 1kg of wood can be calculated using the following equation: 1kg (wood) x 0.45 (carbon content) x 3.67 (CO_2 / C) = 1.65kg CO_2. Assuming that the Cambodian citizens consume 1kg of wood per meal and they use solar cookers instead of wood, about 1,800 kg of carbon dioxide will be reduced per solar cooker annually. On 23 November 2011, officials from ASEIC, SBC, and GGGI, together with local partners, demonstrated the use and efficiency of the solar cookers to over 150 local residents and students in the Takeo region. During the actual demonstration, the villagers enjoyed testing the cooking device and were surprised to find the noodles cooking quickly in the solar cooker. *The Korea Times* published a feature article about the project on 28 November 2011.

2. Mini-Incinerator

For pilot testing, project developers put up twenty mini-incinerators in regions adjacent to Phnom Penh. The construction of mini-incinerator helped the villagers appreciate the importance of collecting their waste for sanitary purposes instead of disposing their garbage everywhere. They learned that while some wastes can be recycled, others can be converted into ash using the incinerator.

[Figure 4] Professor Kim Man-gab of the National Polytech Institute of Cambodia shows SBC Director Tae-sung Lee (left) how the low-cost incinerator works.

[Figure 5] Establishing mini incinerator encourages local consumers to dispose of their garbage properly.

III. SPECIAL FOCUS: ECO-INNOVATION IN ACTION, NURTURING LOCAL OPPORTUNITIES WITH SOLAR COOKERS

This chapter examines the possible means of distributing and selling solar cookers in Cambodia through several case studies. Specifically, the following questions are discussed: What are the characteristics and limitations of supplying solar cookers to low-income consumers in Cambodia? How should the solar cookers be supplied considering such characteristics and limitations?

A. Context

Cambodia is classified as one of the least developed countries in the world. The target market for the solar cooker is low-income individuals in rural areas, also known as the bottom of the pyramid (BOP) market. Three major activities are crucial in order to create and secure the BOP market: (1) localize the production, the distribution, and the marketing of the appropriate technology; (2) involve local residents in the production processes; and (3) foster sustainable enterprises by aiming to scale up by starting with a small profit margin.

Given the limited capital or disposable income of Cambodians, social entrepreneur Martin Fisher said that “even chicken meat is an occasional luxury for BOP. If the appropriate technology product is affordable and can save a sufficient amount of money in the long run, the business can be successful.” According to the survey conducted, people often use wood for cooking, which costs one US cent per piece. Since residents buy ten pieces as a set on the average, the cost per purchase is about 10 cents. If

residents make two purchases a day, the daily cost is 20 cents and the monthly cost is six dollars. Thus, the project intends to look for ways of keeping the monthly cost of solar cookers below this amount as it might be difficult for low-income classes to purchase the technology. This limitation affects the manner in which the technology has to be supplied, which will be explained in the later chapters.

It is not easy to convince residents to change from the old means of cooking of using firewood, into a new eco-friendly way by using renewable energy. While persuading them to try the product is easy, enticing them to adopt the technology in their daily lives requires enormous efforts. Bio-sand filters used in Cambodia to collect rainwater for drinking could be regarded as an example. The facilities were found to be covered with dust, triggering health and sanitary problems. Moreover, the filtered water was also kept under poor storage conditions. Professor Han Mu-young and his team, who are renowned experts on rainfall utilization, had supplied Cambodia with improved rainfall storage systems but it was eventually abandoned by most households since maintenance systems were not secured, in tandem with weak localization.

According to the local survey in Takeo, 70 out of the 97 households use wood for fuel; 14 of them use both wood and gas whereas the remaining 4 use wood and charcoal. Thus, all households use wood for cooking, and 70 of them obtain wood close to their house or from nearby mountains. Most of them would therefore get wood on their own more frequently instead of buying wood from other sources. In order to encourage residents to switch to solar cookers despite the additional cost, we need to take into account the cooking lifestyle of the residents. Since solar cookers depend on sunlight in order to function, it can only be used during the peak hours of sunlight (more or less between 10 a.m. and 4 p.m.), which renders it useless in the evening or in the early morning. On the contrary, low-income families usually cook in the evening. Moreover, the solar cooker's big size may not be suitable to the average size of each household. Since most of Cambodians cook inside their home, using the solar cooker might prompt them to cook outdoors.

These limitations might pose challenges that could be nonetheless overcome by innovative solutions. For instance, the local government may opt to subsidize solar cookers instead of banning the collection of wood from nearby mountains. This action might serve as a better option for the local government since preventing deforestation is more economical than reforestation. In addition, the target market for solar cookers should focus on certain establishments that are mostly active during the daytime such as restaurants, street markets, and schools, rather than individual households. Instead of selling solar cookers to individual households, the government should also consider building a communal cooking space with a sufficient supply of solar cookers

[Table 3] Barriers and Enablers of Distributing Solar Cookers

Barriers	Enablers
The cost of a solar cooker is $160, which is unaffordable for local residents.	The leasing concept with an option to buy means that households do not have to face the initial disbursement.
Resistance to change: Some households may be reluctant to change their old ways of cooking.	Local partner, ISAC often holds demonstration activities in Takeo and Phnom Penh area. This will establish a common ground for sharing best practices and usages. This may encourage those who are most unwilling to participate.
Unpredictable weather conditions (especially in the wet season)	A new technology is needed to save sunlight.
The relatively big size of a solar cooker does not suit the preference of individual customers.	The local government might consider establishing a communal cooking center, which requires extra funds.

[Table 4] Analysis of Relevant Stakeholders

	Needs	Importance	Benefit
Local residents	Safe household conditions	They are central to the model, since they represent the target households, being the primary users of the cooker.	♦ Safer cooking and household conditions ♦ Saves time and effort as they do not have to go out to collect firewood, and carry the heavy load.
Staffs and students of ISAC	Access to income-generating employment opportunities	Since they manufacture the cooker themselves, up-to-date technical training is necessary to ensure product quality, including their ability to carry out repairs, maintenance, or upgrades.	♦ Opportunity to create a micro social enterprise in the region ♦ Learn the technical skill of harnessing solar energy, thereby enhancing their employability.
ISAC School	Adequate funding to improve educational services	ISAC constitutes the fundamental pillar of the distribution system as it hosts the worksite, where demonstration activities are conducted to educate the people on the adoption of appropriate technologies.	♦ Hosting workshops and events will boost the image of the school within the community.
Government	Welfare of the population, improvement of the educational system, living standards and job creation	They are simply passive actor in this ecosystem.	♦ Increased use of clean, renewable technologies ♦ Reduction in the rate of deforestation in the country ♦ Improved health of the rural population and productivity
Microfinance Institution (if it is a viable option in the specific area)	Ensure repayment and keep default rates to a minimum	Microfinance is crucial to the business model since it is unlikely for rural households to purchase the products without obtaining a loan.	♦ Reaching a wider customer base means higher returns from interest loans. ♦ Partnership with ASEIC and GGGI may have positive effects on the reputation of Cambodia's microfinance institutions.

B. Methods of Supplying Solar Cookers

The matrix below shows the options outlined in the previous discussion. The twofold categorization was based on maximizing price affordability; six methods in four different criteria are suggested and each method is distinct but can be combined accordingly. The methods seek to market appropriate technology except for the methods involving donations, which will be tackled separately in this report.

[Table 5] Matrix: Methods of Supplying Solar Cookers

	Cost Burden for Local Residents	
	Minimizing	Maximizing
Ownership	o Microfinance or loans o Corporate subsidization or support from IO/GO/NGOs	o Using the existing distribution channel
User's Rights	o Sell user's rights o Rental service	o Franchising through local residents

1) Rental service

Instead of selling them, solar cookers can be rented out. Borrowers pay only for the amount of time that they rented for. This method may cater to local residents without residual capital. If the monthly fee is set at USD 3 for a year, it can minimize the local residents' cost burden.

Strength	Weakness
o It minimizes the borrowers' cost burden since they only have to pay for the specified time that they rented for. o It reduces initial investment. o The lender takes responsibility for the maintenance of the technology.	o The short-term sales output is small.
Case Study Osram, headquartered in Germany, is implementing an experimental project of supplying photovoltaic lanterns and storage batteries. Residents who fish around Lake Victoria often use kerosene in the late evenings to attract fish, which puts the areas at high risk to fire. In addition, the rising oil price lessens the commercial viability of kerosene. In response, Osram established a small-scale photovoltaic system named O-hub and has been lending rechargeable "O-lantern" to fishermen. Osram chose the rent method because the products were not marketable to low-income residents. The fishermen pay a small fee for the lanterns, which they recharged upon return. They pay a deposit of $10, which they get back when the rent period ends. However, even $10 can be too expensive for many residents. On that note, Osram has been collaborating with local micro-finance institutions to extend credit for the deposit.	

2) Selling User's Rights

This method involves the selling of user's right when using the solar cooker, thus neither selling nor lending the technology. If residents find the rental cost too high or if they feel that the installation cost is unreasonable, this method may be applicable. This scheme, however, requires a communal cooking space for each town. In the absence of a vacant lot, existing schools or town centers might also be an alternative. The "cooking center" does not need to be operated by the service provider; it can offer business opportunities for the local residents through franchising. Corresponding details are provided separately.

Strength	Weakness
o The technology can be maintained efficiently when the service provider works at the cooking site. o Since solar cookers can only be used on some specified time during the day, local residents are relieved of the ownership cost of the cooker and the risk of damage when the technology is not in use. This option is thus economical and reasonable for the users.	o There are additional costs for setting up the cooking site or center.
Case Study The Byrraju Foundation in India provides filtered drinking water to the local residents in rural agricultural areas via pay-per-use scheme. In general, a filtering system for a household costs approximately USD 18 to USD 30. An additional fee of USD 8 is charged for changing the filter. The total cost is quite burdensome for the local residents whose average monthly income is only USD 60. The Byrraju Foundation is providing filtered water at USD 4, which is half of the maintenance fee by building a small-scale local water filtering center. The foundation is in charge of changing the filters and managing the filtering systems. Local residents only pay for the amount of water they get. So far, Byrraju Foundation has established 57 local water filtering centers, providing drinking water to 85,000 people. Over 75 percent of the water filtering centers has exceeded the break-even point.	

3) Using the Existing Distribution Channel

Constructing a new distribution channel solely for distributing solar cookers is a daunting task; it thus makes sense to utilize the existing ones. Through the network established by the local partners within the project area, they can easily gain the trust and support of the local residents. For example, Coca-Cola was able to set up its distribution channel even in the remote areas in Africa and this was used for HIV-AIDS prevention campaign. The possibility of using the existing distributional channels is not only limited to corporations but also to schools, local grassroots organizations, and NGOs.

Strength	Weakness
o The distribution cost can be reduced by utilizing the existing distribution channel and network. o The familiar network with the local residents easily builds trust and support for the project.	o Relying on the existing distribution channels will inflict considerable pressures to ensure the quality of the product as it would be highly affiliated with the corresponding distribution channel itself.
Case Study D-Rev is a non-profit organization that designs and supplies appropriate technology products such as low-cost prosthetic legs in developing countries. D-Rev has been collaborating not only with the Indian government but also with the Jaipur Foot Organization, the world's biggest prosthetics supplier. Jaipur was established in 1975 and has been providing custom-made prosthetics through its clinics across India. It also offers recovery support, counseling services, and specially-designed shoes. D-Rev introduced an innovative product, JaipurKnee, a low-cost, high-performance prosthetic knee joint for amputees. On the other hand, SolarAid, a company providing photovoltaic products, utilizes local schools as a distribution channel since there are many schools in most of its target areas. Thus, the schools serve as the bridge for SolarAid to reach out to the local residents. Specifically, SolarAid collaborates with school teachers in marketing and selling the photovoltaic products to the parents. In the process of installing solar photovoltaic systems to community centers, medical clinics, and other public establishments, it trains local communities to do the installation on their own.	

4) Franchising through the Local Residents

Franchising that involves the local residents allows them to play multiple roles as producer, distributer, seller, and user of the technology. It also opens entrepreneurial opportunities for the local residents, thereby generating new sources of income. If the local government can create an enabling environment for this, it might serve as a model for the nearby towns that might be interested in exploring the idea of franchising appropriate technology.

Pros	Cons
o It could easily win the trust of the local residents as they are able to handle the entire process of technology management. o If the franchise activities reach a number of towns, the number of distribution channels in charge of maintenance can be reduced. As such, strategies can be adjusted according to the corresponding change in environment.	o It may be difficult to find locals who are competent enough to manage the franchise. o Franchising is a type of business run by individual or a group of entrepreneurs that requires proper training to be successful.
Case Study Green-Danone is a concrete example of success in the franchise business. It is a social enterprise that seeks to improve the nutrition of children in Bangladesh by distributing fortified yogurt in the rural areas. In order to set the fortified yogurt's price to one third of the regular yogurt's price, Grameen-Danone started working with a woman's organization called Green Women. Its members – who are women mostly in charge of housework – are mobilized to go around the town to distribute the yogurt provided by Grameen-Danone. A more sophisticated franchise model is the photovoltaic project in Haiti. The initiative brings photovoltaic charging systems built in trailers into the town and rent them out to local residents. The local residents then take the charged batteries home or bring their electronic appliances to the trailers to recharge. This method allows individuals who have rented the systems to reutilize them as their own franchise and re-sell them to local residents.	

5) Microfinance or Loans

Microfinance is the most common method to supply appropriate technology to the BOP market as not all households who used to pay for cooking fuels can afford the solar cookers. If the price of a solar cooker is set at USD 160, the estimated monthly fee would cost USD 5 to USD 10. If they are to pay about USD 5 to USD 10 a month with 20 percent interest through microfinance, it would take about 20 to 40 months for them to repay the entire loan. In addition, consumers often borrow money by groups rather than individuals, where five persons can form a group in order to co-purchase and co-own a solar cooker. Even without microfinance, the residents could start their own loan programs and create their own rules on initial deposits, interest, monthly payments, and repayment periods, etc.

Pros	Cons
o By reducing the cost in the early stage of credit financing, local residents can purchase solar cookers at a reasonable monthly payment. o Collaborating with micro-financial institutions reduces the financial burden of the local residents.	o Without micro-financial institutions in the locality, one must look for skilled organizations or groups interested in this project and teach local residents about the concept and principles of micro-finance.
Case Study Grameen Shakti is a social enterprise established in 1996, which strives to eradicate poverty in Bangladesh and now runs 1,097 branches across the country. They have distributed over 650,000 solar home systems (SHS), 18,000 bio-gas systems, and 320,000 renovated stoves. The lowest price of SHS in rural areas is USD 130, which is still too expensive for the low-income class. In response, Grameen Shakti started a monthly-installment program: the buyer pays 15 percent to 35 percent of the full price as the initial deposit and repay the rest at 5 percent to 8 percent interest rate for 12 to 35 months. This microcredit scheme enabled more than 140,000 people to own solar home systems.	

6) Corporate Subsidization

In order to significantly reduce the cost of purchasing solar cookers for the local residents, corporate subsidization or joint-marketing with corporations is another option. In the summer of 2011, Hyosung launched an initiative that binds appropriate technology and corporate social responsibility through

the project called “Blue Challenger Appropriate Technology College Student Volunteers.” About 30 college students distributed solar lanterns and water filter technology to Vietnam and Cambodia. Solar cookers are also used for CSR activities under the project, “College Overseas Volunteer Program.” Furthermore, a British company called Stoves Online provides various modern stoves and they have been supplying renovated stoves to Cambodia and Guatemala to reduce carbon emissions in line with EU’s implementation of mandatory emissions trading system. In Korea as well, solar cookers can be supplied as a CSR project in the wake of the government’s call for reducing carbon emissions. This is

an effective initiative to pursue should the government follow the European directive of imposing emissions trading policy.

Pros	Cons
o Better product sales and supply due to corporate sponsorship. o Increased awareness of the product as the media promotes the corporate project.	o Might be highly dependent on the corporations' varying goals or preferences, supply areas, targets and timeline. o Corporations may not consistently participate due to economic reasons.
Case Study Q-drum is one good example of appropriate technology. It is a circular water tank that allows even a small child to drag a 50-liter water tank. As the water tank needs to be molded in circles, the production cost is high. One Q-drum costs about $60 (if more than 500 Q-drums are purchased, it is $53 a drum), which the local residents cannot afford. To solve this problem, Q-drums are sold with corporate logos attached to them.	

7) Other Options

Aside from the six methods discussed above, there are also other methods of supplying solar cookers.

a. Utilizing Kopernik, an Online Platform for Appropriate Technology

The Kopernik (www.thekopernik.org) is an appropriate technology platform that matches the demand for and supply of appropriate technology. When a company with innovative technology and product posts the information online, local NGOs that are interested in the product can discuss more details with the company, such as the method of distribution and supply, collection of donations online, and others. In this way, Kopernik is able to bring the appropriate technology into the attention of local institutions. Such strategy can also be used for solar cookers.

b. Securing Venture Capital

This initiative secures venture investment funds for social enterprises at the local level. Venture investment capital can be categorized into either grants or loans based on the project's objectives and expected outcomes. Aside from the domestic business body, partnerships with the project

implementers in the locality must be established and a specific business plan must be written. Since the fund is most likely to be large, this is best suitable for long-term business plan (more than five years). Some social venture capital firms that are active in the field of energy are E+Co (www.eandco.net), Ennovent (www.ennovent.com), Bambo Finance (www.bamboofinance.com), Solar For All (www.sfa-pv.org), and New Philanthropy Capital (www.philanthropycapital.org).

c. Securing Business Potential by Entering the United Nations Global Marketplace

The United Nations Global Marketplace is a 14-billion dollar market that deals with various products needed for development work and relief activities. SMEs have more advantage in this market than large corporations since they are more flexible to the demands of the field and thus can plan accordingly.

The bid ends within a month after the notice of demand. Therefore, fast market research, production plans, and distribution plans are of paramount importance. If solar cookers are for bid in the marketplace, they can be sold efficiently given a notice of demand and an adequate supply. Until November 2011, there has not been a notice of demand for solar cookers. However, there are demands for solar systems in general including solar panels and photovoltaic materials.

Along with UNGM, building ties with UN projects in Cambodia is another possibility. There are 26 UN organizations working in Cambodia. Among these institutions, the United Nations Industrial Development Organization has so far implemented 26 projects worth $3.7 million in the areas of carbon emissions reduction, climate change, energy, and agriculture.

Ⅳ. CONCLUSION

This pilot project aims to examine the feasibility of fostering business opportunities for local entrepreneurs through appropriate technology, specifically the use of solar cookers and waste incinerators in the local communities in Cambodia. The project was successfully carried out by transferring green technologies suitable and appropriate for the local situation in Cambodia and building the capacity of local residents to produce the technology. However, the project has yet to equip local people to use the items in the market since they do not have proper micro/small businesses to be involved. In order to make the products sustainable, we hope to support a creation of micro social enterprise in the region of Takeo with the help of local partners and relevant institutions including a local incubator based in Phnom Penh. This will be realized by extra funding opportunities for further production of solar cookers and its related items, technology transfer with proper educational practices, and marketing strategy as a follow-up project. As presented in the Special Focus section, there are various options to be considered. In the meantime, we need to carefully take into account the positions of relevant stakeholders from funders to local recipients.

In addition, mini-incinerators were also successfully installed in 20 places near Phnom Penh, leading to improved local sanitation. Although the initiative gained positive feedback from the local residents, it is unwise to support the production of incinerators since the original technology is opened during the pilot project and it can be easily applicable to the local people if local governments or institutes are willing to follow the model.

Since the use of appropriate technology in the local community requires a bottom-up approach, collaboration with the local partners is essential. Fortunately, the overall project implementation went smoothly and one winning factor behind its success is the good working relationship of the local partners with the villagers. This experience underscores the importance of gaining a deeper understanding of the people's culture and the local environment in order to build mutual trust.

Lastly, some useful lessons learned during in the project are worth noting. First, local residents of the targeted regions must be strategically included in the production, sales, and distribution processes. It is crucial to strengthen at a local level their capacity and enable the beneficiaries to perform designated roles. In expanding the solar cooker business, it will be very important to come up with ways to cultivate local labor force for the production, sales, and distribution of the technology. In addition, collaboration with existing local groups or leading groups must take place prior to the adoption of appropriate technology. If the local communities were not informed or educated about the products, the business might face difficult challenges. In that sense, the project team will be aligned with GGGI-Cambodia Green Growth Program to gain local support from the Cambodian government.

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