Project ID: P003700	*Project Name:* Solar Home Systems
Team Leader: Esperanza Miranda	*TL Unit:* EASIN
ICR Type: Core ICR	*Report Date: June 21, 2004*

1. Project Data

Name: Solar Home Systems
L/C/TF Number: TF-28488
Country/Department: INDONESIA
Region: East Asia and Pacific Region

Sector/subsector: Renewable energy (95%); Central government administration (5%)
Theme: Climate change (P); Rural services and infrastructure (P); Other financial and private sector development (P); Infrastructure services for private sector development (P)

KEY DATES	*Original*	*Revised/Actual*
PCD: 11/30/1994	*Effective:*	10/01/1997
Appraisal: 07/06/1996	*MTR:* 05/31/1999	09/22/2000
Approval: 01/28/1997	*Closing:* 04/30/2002	12/31/2003

Borrower/Implementing Agency: GOI/BPPT AND DGEEU
Other Partners: IBRD

STAFF	Current	At Appraisal
Vice President:	Jemal-ud-din Kassum	Marianne Haug (Acting VP)
Country Director:	Andrew D. Steer	Marianne Haug
Sector Manager:	Junhui Wu	Peter R. Scherer
Team Leader at ICR:	Yuling Zhou	Arun Sanghvi
ICR Primary Author:	Esperanza Miranda; Peter Meier (Consultant); Yuling Zhou	

2. Principal Performance Ratings

(HS=Highly Satisfactory, S=Satisfactory, U=Unsatisfactory, HL=Highly Likely, L=Likely, UN=Unlikely, HUN=Highly Unlikely, HU=Highly Unsatisfactory, H=High, SU=Substantial, M=Modest, N=Negligible)

Outcome: U
Sustainability: L
Institutional Development Impact: SU
Bank Performance: HS
Borrower Performance: S

	QAG (if available)	ICR
Quality at Entry:	HS	HS
Project at Risk at Any Time:	Yes	

The project was at risk several times during its implementation period (1998-2003) as weak country conditions contributed to the low levels of SHS sales and prospects for large-scale market development became limited, which led the project to be rated unsatisfactory in either implementation progress and development objectives.

3. Assessment of Development Objective and Design, and of Quality at Entry

3.1 Original Objective:

The **national objectives** of the project, as stated in the SAR, were to: (i) provide modern energy form of electricity in an environmentally sustainable manner to rural consumers who cannot be economically served in a timely manner by conventional rural electrification; (ii) facilitate participation by the private sector in advancing renewable energy commercialization; (iii) promote environmentally sound energy resource development in Indonesia and reduce the energy sector's dependence on fossil fuels; and (iv) strengthen Indonesia's institutional capacity to support and sustain decentralized rural electrification using solar photovoltaics.

The **global environmental objective** was to mitigate emissions of CO_2 by displacing the use of fossil fuels such as kerosene for lighting or diesel-based power generation, with SHS. A related objective was to remove barriers to large scale SHS market development.

These objectives were clear and realistic, and reflected Indonesia's priorities for rural development and rural electrification at that time. Indonesia's Outlines of State Policy (1993) recognized the importance of meeting the country's rapidly growing energy needs efficiently - through conservation, diversification, and more efficient utilization of primary energy resources. Further, the GOI viewed rural electrification as a key and integral part of rural development, and Indonesia's long term goal was to electrify all villages and enable the basic services provided by electricity.

The objectives had clear links to the Bank's prevailing Country Assistance Strategy (CAS, 1995 and CAS Progress Report, 1996) as well as the on-going operations at the time of project preparation/GEF grant approval (1996/1997), which aimed at assisting the country to meet its critical demand for electricity in an efficient and environmentally sustainable way. The CAS supported renewable energy development, and recognized the potential role for off-grid decentralized rural electrification (RE) as a complement to the least cost grid extension program. The Solar Home System (SHS) project was designed to continue the Bank's dialogue with the GOI and to support the implementation of a sustainable and environmentally sound RE development program, which was initiated in the Rural Electrification Project (Loan 3180-IND) and continued through the Second Rural Electrification Project (Loan 3845-IND) and the Renewable Energy Small Power Project (Loan 4198-IND, which was expected to finance grid-connected renewable energy power generation but never became effective due to the 1997 regional financial crisis).

In addition, the SHS project was fully consistent with the GEF Operational Strategy of promoting adoption of renewable energy by removing barriers and reducing implementation costs. The barriers targeted by the project included the lack of established large markets for SHS, and the lack of term credit for SHS purchases.

3.2 Revised Objective:

The project objectives were not revised during project implementation.

3.3 Original Components:

The project consisted of two major components:

(1) **Credit component** – comprised an IBRD loan (US$20 million) and a GEF grant (US$20 million) - to enable purchase of solar home systems by rural households and commercial establishments on an installment plan basis. Under the credit component, the project was to provide electricity to about one million people in three provinces - West Java, Lampung and South Sulawesi - through the sale and

installation of 200,000 PV systems in homes, and commercial establishments such as small shops. The sales of SHS units would be undertaken by private enterprises ("SHS dealers"), who would take responsibility for procurement of components, installation and maintenance, and enter into hire-purchase-contracts with the households. The SHS dealers would extend credit to rural households to enable them to pay for their units on regular monthly installments. Participating local commercial banks ("Participating Bank" - PBs) would provide credit, on normal commercial terms, to SHS dealers, to enable them to sell solar home systems on an installment plan basis as well as to finance their ongoing operations, for up to five years. The PBs, in turn, would re-finance 80 percent of the credit extended to SHS dealers from the IBRD loan made available to them at market rates, under on lending arrangements through the Government of Indonesia (GOI). The GEF grant would provide payments to SHS dealers for each SHS unit sold and installed (US$75 per unit installed in Java and US$125 per unit installed in Lampung and South Sulawesi). These arrangements were modified later during project implementation in response to changing market conditions.

(2) **Technical assistance component** – consisted of technical assistance for: (i) implementation support - to establish a Project Support Group (PSG) to provide assistance to SHS dealers and end-users, monitor and evaluate project progress, and conduct limited SHS related training to government officials and private sector organizations; (ii) policy support - to carry out and prepare a Decentralized Rural Electrification Study and SHS Implementation Plan; and (iii) institutional development - to assist GOI in building Indonesia's institutional capabilities for the dissemination of solar PV technology, mainly BPPT-LSDE capability to technically certify SHS systems and establish national SHS component standards. An amount of US$4.3 million from the GEF grant was allocated to support the technical assistance component.

3.4 Revised Components:

The original components of the project were not changed during project implementation. However, soon after the project became effective (October 1997), it became clear that adjustments to the project were required to respond to the deteriorating economic and political situation in Indonesia as a result of the East Asia financial crisis. Beginning in 1998, significant realignments were made by amendments to the legal agreements along with a number of non-structural modifications on an on-going basis in line with findings of the supervision missions. The main realignments were:

Minimum size of SHS system eligible for a grant was reduced from 50 Wp to 10 Wp. To counter the reduced affordability of the 50 Wp system, technical specifications were modified to provide for a 10 Wp minimum size system. Grant amounts were accordingly established, in 1998, for the smaller size systems.

Bank loan reduced and closed ahead of schedule. Less than $0.1 million of the $20 million IBRD loan was utilized by December 2000. There was no demand for the loan from the dealers and the PBs were not in a position to offer fresh credits to the dealers following the banking sector crisis. Thus, the loan was closed on January 31, 2001, fifteen months ahead of the original schedule of April 30, 2002.

GEF grant reduced. With the closing of the IBRD loan in January 2001, the GEF grant was also reduced from $24.3 million to $11 million, and further reduced to $5.2 million in April 2003 because of diminishing sale prospects for SHS.

GEF grant closing date extended, then brought back. In reconfiguring the project as a stand-alone GEF operation, the closing date was extended by two years to April 30, 2004, to offset the impact of the country's financial crisis on the participating banks and dealers, and to respond to the promising market conditions that prevailed in mid-2000. However, as the positive prospect gave way to high uncertainties due to political turmoil, civil unrest and financial trends during much of 2001-02, the World Bank and the

Government concluded that the project was not likely to achieve any further strategic market development benefits or significant sales in the near term, and it was agreed to close the GEF grant ahead of time on December 31, 2003.

Grant sales eligibility changed. In 2000, the basis of the grant to dealers was changed from per unit basis to per unit of power output (per Wp) basis. The shift to a per Wp grant would permit sales of larger systems to be eligible for proportionally larger grants, while lowering the minimum size would enable sales of affordable units on a cash basis to a wider market segment.

Number of project areas expanded. In early 2003, five kabupaten were added to the project's market areas to enhance sales potential in areas adjoining the current areas.

TA study canceled. TA for a *Decentralized Rural Electrification Study and the Solar Home System Action Plan* was replaced by *Renewable Energy for Rural Transformation Study and Action Plan*. This change, arising from the increasing focus in Indonesia and the Bank on poverty reduction, was to focus the study and plan on utilizing renewable energy for social and economic development of rural communities. However, the study had to be cancelled in 2002 given the limited time available and procurement delays related to consultant selection.

3.5 Quality at Entry:

The project quality at entry was rated "Good" (highest rating) by QAG's First Quality at Entry Assessment in 1998. According to this assessment, projects rated "good" were projects with high probability of meeting their development objectives and with substantial elements of best practice. The project received top ratings in five of the eight quality dimensions reviewed by QAG, namely, (i) project concept, objectives and approach; (ii) technical, economic and financial aspects; (iii) environmental aspects; (iv) social and stakeholder aspects; and (v) Bank inputs and processes. Based on this review, the project team was honored for Excellence in Quality by the Bank senior management in 1998. The essential elements of this project design have since been incorporated, with appropriate changes and refinements, in a number of Bank/GEF-financed solar PV projects in Asia (Sri Lanka and China) and Africa (Uganda). Most importantly, the basic concept is now well-accepted that Bank-GEF projects can set up functioning markets for solar pv products in remote, rural areas by helping to establish dealer supply chains on the one hand and informed consumers on the other hand, with performance-based grants to kick-start the process.

4. Achievement of Objective and Outputs

4.1 Outcome/achievement of objective:

The achievement of the project objectives is mixed. Project efforts to develop a large scale market for SHS were largely hampered by the financial crisis of 1997 - which hit the country as project implementation started - and by the resulting weak business environment. As a result, the project fell short of achieving the key performance targets set for its national and global objectives, and the overall outcome of the project is therefore rated unsatisfactory. Nevertheless, while the actual SHS sales fell far short of the appraisal target, the project has had substantial results in the areas of institutional development and laying the foundations for a well-functioning solar PV market. A detailed discussion of each the project objectives follows.

Provide the modern energy form of electricity to rural customers who cannot be served economically or in a timely manner by conventional rural electrification. The key performance indicators (KPIs) established to measure the achievement of this objective were the number of SHS units sold per year and the cumulative number of people served by the Project. The macro-economic crisis in 1997 substantially

hampered the project's efforts to introduce large-scale commercial SHS market development in rural areas as economic conditions (high inflation, high interest rates, sharp local currency devaluation and falling incomes) greatly reduced consumer affordability. Also, the country's financial sector made it difficult for the original four participating banks, which were among the uppermost tier of top rated banks in Indonesia at the time of appraisal, to provide financing to the SHS dealers. Consequently, SHS sales levels until late 2003 were consistently below expectations. By the end of the project, a total of 8,054 SHS units, serving about 35,000 people, were installed. This level was well below the appraisal targets of 200,000 units serving about one million people, and below even the January 2001 revised targets of 70,000 units and 300,000 people, respectively. **Therefore, the achievement of this objective is rated unsatisfactory.**

Facilitate participation of private sector in advancing renewable energy commercialization. Achievement of this objective was measured against the following performance indicators: (i) number of dealers, to measure the extent of market development; (ii) number of dealers with "problem loans" by PBs, to measure the extent to which the Project was successful in establishing a sustainable delivery mechanism; (iii) installed price, to measure the cost-effectiveness of the SHS units in meeting the customer's needs; and (iv) customer timely repayment rates, to measure customer satisfaction with their SHS systems and also the extent of cost recovery. By the end of the project, the number of participating dealers had increased to six from only one dealer operating at the end of 2000; there were no problem loans among dealers except for a small nominal loan to one dealer in 1990; dealers reported credit repayment rates of above 95% (most of the units were purchased on dealer-supplied credit); and SHS prices were reduced to the range of $450 to $525 for a 50 Wp system (compared to actual prices ranging from $550 to $800 at appraisal). **Therefore, the achievement of this objective is rated satisfactory**.

Further, the project encouraged local Indonesian firms to manufacture "balance of system" components of SHS (excluding the solar PV panels), had them tested initially on a grant basis at international laboratories and subsequently on a commercial basis at the LSDE/BPPT laboratory (after this had been ISO 25 qualified) to check whether they met the project's technical specifications, and arranged for technical support from interested international organization to improve their quality. Two companies that received assistance with component design and testing are now exporting the components. One of these companies, while still relatively small, is becoming a major exporter of some integrated balance of system components, contributing, for example, to sales in Sri Lanka under the World Bank supported Energy Services Delivery Project and to commercial sales in Kenya. Another company whose development has been supported under the project has sold systems in rural areas under the World Bank-financed Kecamatan Development Project in Indonesia and other provincial and local government-supported rural energy programs.

Promote environmentally sound energy resource development in Indonesia and reduce the energy sector's dependence on fossil fuels. Achievement of this objective was to be measured by the amount of fossil fuel conserved. Although the development impact study conducted under the Project found that the use of kerosene for lighting among the SHS uses decreased in average by 45.7%, or from 25.9 liters to 14.1 liters per month, the cumulative amount of fossil fuel conserved under the project amounted only to 20,441 kilo-liters as opposed to the original target of 546,720 kilo-liters, as result of the lower number of SHS units sold under the project. **Therefore, the achievement of this objective is rated unsatisfactory.**

Strengthen Indonesia's institutional capacity to support and sustain decentralized rural electrification using solar photovoltaics. Achievement of this objective was to be measured by (i) strengthening BPPT's capacity to certify the technical capabilities of solar PV systems through technical assistance and project support activities, and (ii) the completion of the *Decentralized Rural Electrification Strategy Study and SHS Implementation Plan*. Implementation of the TA for institutional development and project support

activities was carried out in a highly satisfactory way and resulted in the following positive outcomes: **first**, strict technical criteria and procedures for testing and certification of SHS units were developed within the Technical Implementation Unit and Energy Technology Laboratory (LSDE) of the Indonesian Agency for Assessment and Application of Technology (BPPT). These technical standards are now being used, with adaptations, in a number of other countries (Sri Lanka, China and Uganda). Further, these standards also formed a base for the activities of an international NGO, Photovoltaic Global Approval Program, which is developing a Seal and Mark of quality; **second,** technical assistance provided through the project enabled the Photovoltaic Testing Laboratory of BPPT to obtain ISO 17025 accreditation for PV components testing, which was beyond the original target. This certification has allowed the laboratory to achieve international standing for testing and certifying balance of system components. The laboratory has tested and certified products from the USA, Indonesia and the Netherlands that have been accepted for use under World Bank projects in other countries; and **third**, the Project Support Group (PSG), established under the Project, effectively carried out field audits and other monitoring responsibilities and provided capacity building and technical assistance, including the training of more than 479 staff in the rural distribution networks of the participating companies.

The *Decentralized Rural Electrification Study and SHS Implementation Plan* was reformulated as a *Renewable Energy for Rural Transformation Study and Action Plan* in response to the Borrower's request to develop a strategy for renewable energy for rural transformation. After several months of procurement preparation, DGEEU (previously DGEED) decided not to conduct the study given the limited time available and Bank procurement requirements. Despite the disappointing cancellation of the latter study, the outcomes achieved under the remaining TA activities, as described above, have been substantial, and **therefore the achievement of this objective is rated highly satisfactory.**

Mitigate emissions of CO_2 in Indonesia. Due to the small scale of SHS units sold and corresponding environmental benefits when compared to the appraisal targets, **the achievement of this objective is rated unsatisfactory**

Other Benefits

In addition to the above outcomes, it is recognized that the project has had other beneficial effects that go beyond the project itself:

(i) the relatively ambitious scale of the project and the Bank/GEF's continued support for the project in difficult economic times sent a clear signal to solar PV dealers and supply companies that the Bank and GEF were seriously committed to the development of commercial solar PV distribution in particular, and renewable energy in general;

(ii) the project's demonstration effect of a semi-commercial approach for SHS market development will be a strong input into decisions on official subsidies for SHS and similar projects in the future. The project demonstrated that approximately 20% of credit subsidy was sufficient to provide renewable energy to rural households, rather than the 90-100% subsidies often found in donor and government (including local government) supported programs. The price reductions have also shown that cost savings are possible; and

(iii) some of the innovative design features of the project have since been utilized in other Bank/GEF-financed projects. These include a transparent and simple system to administer performance-based GEF grants to dealers, within a commercial and competitive framework, with a project scale that enabled a clear commercial exit strategy. This system also provided for end-user audits to verify

and monitor dealer performance. In contrast, prior to this project, solar PV projects in most countries typically followed a government procurement approach, even in situations where governance structures were not sustainable and did not lead to a self-sustaining commercial solar PV market.

4.2 Outputs by components:

Credit Component

After the closing of the IBRD loan in January 2001, the GEF grant continued supporting the implementation of the credit component by providing grants payments to SHS dealers for each SHS sold and installed under the project. After project realignment, grant payments to SHS dealers were changed to per Wp basis. Dealers received a grant payment of $2/Wp for systems, 10 Wp and above, sold in any of the market areas. As of September 30, 2003 (which was set as the deadline by which dealers could submit grant applications), a total of 8,054 SHS units had been sold in the areas of South Sulawesi, Lampung and West Jawa, of which 4,139 (51%) were sold in 2003 alone (Table 1). SHS sales accelerated in 2003 in response to the increased consumer affordability as commodity prices (mostly cacao and palm oil) improved, and the increased competitiveness resulting from reduction of subsidies on competing products such as kerosene and diesel. Over half of the units sold under the project were 50 Wp system (Table 2) with retail prices ranging from US$450 to US$525 compared to US$550 to US$800 at appraisal.

Six participating dealers were active at the end of the project (compared to only one at the end of 2000, when the IBRD loan was about to close). One of these dealers, however, did not make grant eligible sales under the project. Most of the sales (95%) were financed through dealer-supplied credits over 2 years with 20% to 30% down payments (Table 3). Four of the six participating companies have expressed that they will continue expansion of rural retail distribution networks and sale of SHS on a fully commercial basis.

Of the four participating banks that initially signed agreements to participate in the project, only one bank worked actively with SHS dealers throughout project implementation. By end 1997, as a result of the financial sector crisis and the contraction of the banking sector, one of the banks was closed and the other three were barred by Central Bank from issuing fresh credits to any customers. One of these three stopped operating in 1999. In mid-2000, the two remaining banks were refinanced and were permitted to offer fresh credits. However, only one bank provided for near-term expansion in the SME sector targeted by the project.

The IBRD loan and GEF Grant Agreement had prohibited the charging of any fees for processing grant payments, as it was expected that PBs would be able to recoup their costs through the normal fees that they would be earning on their loans and other banking services that they would be providing to the dealers. However, when the IBRD Loan was closed, it became clear that the PBs would not earn any significant fees from loans to dealers. The Bank then agreed in 2001 to allow PBs to receive U$100 as processing fee for each batch of grant payment requests.

Table 1: Summary of SHS Unit Sales

Market Area	1999	2000	2001	2002	2003	Totals
South Sulawesi	76	997	708	200	1,184	3,165
Lampung	14	281	686	648	2,197	3,826
West Java	2	21	158	124	798	1,063
Total	**92**	**1,299**	**1,552**	**972**	**4,139**	**8,054**

Table 2: SHS Sales by Unit Size and Market Area

Market Area	32 Wp	40 Wp	42 Wp	49.3 Wp	50 Wp	53 Wp	60 Wp	100 Wp	Total
South Sulawesi	6	1,585	251	2	1,285			36	3,165
Lampung	3	338	25	437	2,935	56		32	3,826
West Java	2	75	3	82	795	28	1	77	1,063
Total	**11**	**1,998**	**279**	**521**	**5,015**	**84**	**1**	**145**	**8,054**

Table 3: Consumer Financing Terms

Dealer	**Down Payment**	**Interest (Flat rate)**	**Credit Term (Months)**				**Cash**	**Total Sales**
			18	24	30	36		
A	20%	24%		2,594			155	2,749
B	30%	24%		945	2,034		178	3,157
C	20%	18%				1,224	73	1,297
D	30%	18%	373				22	395
E	30%	22%		430			26	456
Total			**373**	**3,970**	**2,034**	**1,224**	**453**	**8,054**

A total of 7,712 end-user audits of the SHS installed under the project were conducted by PSG successfully. The purpose of the audit was the verification of SHS sales and installations, and compliance with technical standards and consumer protection requirements. These audits consistently found high consumer satisfaction levels with the SHS performance and continued strong rural consumer interest in purchasing SHS, with the only negative comment being that many customers would like higher rated systems capable of powering color television.

Technical Assistance Component

The project's technical assistance component for institutional strengthening was highly successful, and was completed ahead of schedule by BPPT/LSDE in 2000. A national certification and testing facility was established at LSDE with ISO 17025 accreditation received in June 2001. In addition, the project also developed excellent in-country testing and certification capabilities within the BPPT-LSDE. All staff training activities were completed on schedule.

In terms of implementation support, BPPT contracted a consultant firm to establish the Project Support Group (PSG). The PSG successfully set up an effective system for approving dealers, monitoring the actual performance of SHS, auditing sales data for GEF grant release and extending technical assistance to banks and dealers (particularly on market and business development matters).

Under the policy support sub-component, following procurement delays, the DGEEU decided in 2002 not to proceed with the planned study on Renewable Energy for Rural Transformation.

Pilot development impact study

A pilot development impact study was conducted in Lampung of 50 households with and 50 households without SHS. The study was carried out in three steps of data gathering and analysis. The first was to establish the base line data by interviewing the respondent households on the day of the SHS installation in their houses. The second step was the first follow up round of research which aimed at initial observations and estimates of the impact of the use of SHS over the initial six months. The respondents who had installed the systems and the control group were revisited and interviewed based on the same variables of the baseline survey. The respondents were revisited during the third and final round of survey at a point

approximately one year after the installation of the systems.

The study found positive impacts of SHS, ranging from additional lighting for more hours of study by children, reductions in expenditures for kerosene, increased use of the SHS house for social gatherings to enhanced appreciation of the house. On the other hand, the use of SHS has not directly improved the household income except for a few households whose shop services could be extended until late at night. The gender allocation of roles in the household was not found to be affected by the SHS, other than perhaps to reinforce the role of the women in domestic tasks such as cooking and cleaning.

4.3 Net Present Value/Economic rate of return:

According to the SAR (para 4.16), two types of benefits were taken into account in the economic benefit-cost analysis: (i) global environmental benefits and (ii) local benefits that accrue directly to households. The local benefits were calculated by the household's "willingness-to-pay"(WTP), taken as the households' actual SHS expenditures. Global environmental benefits were calculated as per Bank Guidelines (OP 10.04, Paragraph 8). The SAR showed an ERR of 11.6% without GEF benefits, and 39% with GEF benefits.

The ICR for the IBRD loan followed the same approach used at appraisal to re-estimate the ERR, though adjusted for the much smaller number of SHS actually sold in 1999 and 2000. An ERR was not calculated, for reasons explained in Annex 3.

Two rigorous methods of computing benefits were used in the present GEF-ICR: (i) **avoided costs**: benefits are taken as the avoided *economic* costs of kerosene, candles, dry cells and battery charging; and (ii) **change in consumer surplus**: benefits are taken as the change in consumer surplus, adjusted for transfer of payments (i.e. for both the with and without SHS case, the consumer surplus is calculated as the area under the demand curve less costs: the net benefit is the resulting change in consumer surplus). The detailed economic and financial analysis is provided in Annex 3.

Using replacement costs as the method of calculating benefits, the ERR is estimated by this ICR at 24.1% before the GEF benefit (compared to 11.6% at appraisal), and at 32.7% with the GEF benefit (compared to 39% at appraisal). When consumer surplus benefits are added, the economic benefits are larger (ERR of 30.6% before GEF benefit, and 40.9% with GEF benefit).

Table 4: ERR

	ERR, before GEF benefit	ERR, with GEF benefit	Method used to calculate benefits
At appraisal	11.6%	39%	
IBRD-ICR	Not calculated	Not calculated	
GEF-ICR	24.1%	32.7%	Replacement cost
	30.6%	40.9%	Change in consumer surplus

Table 5: NPV

	Number of SHS	NPV before GEF	NPV with GEF
At appraisal		$1.1m	$15.3m
IBRD-ICR	1,391	$2.1m	$2.2m
GEF-ICR	8,054	$2.06m	$2.6 m

Even though the number of SHS installed is substantially smaller than expected at appraisal, the ERR is significantly higher. This is due to the increase in international price of kerosene (which at time of appraisal was atypically low), and decreases in the real cost of PV panels and their installation cost.

4.4 Financial rate of return:

Although not calculated at project appraisal, a financial rate of return has been calculated at project completion in this ICR. Based on a representative sample of consumer financing terms (i.e. 20% down payment, and a two year loan at 24% interest), the financial rate of return (FRR) to the household purchasing SHS is 14.6% - which is above the discount rate, though perhaps still somewhat lower than the discount rate typical of rural households. However, there remain substantial subsidies on kerosene, and the FRR would be significantly higher if this subsidy was reduced. At present levels of kerosene subsidy and the difficulties of obtaining consumer credit, the market penetration of SHS will remain modest without further government support.

A comparison of economic and financial flows among several stakeholders (i.e. consumer, dealers, financing institutions, and government) for a single household with SHS revealed that the government is the biggest beneficiary of the SHS, because it avoids the substantial kerosene subsidy, while the financial benefit to consumers, as noted above, is modest. The details of this analysis are shown in Annex 3.

4.5 Institutional development impact:

The project's institutional development impact is substantial. The project successfully helped strengthen BPPT-LSDE's capability to technically certify SHS by carrying out system testing as well as product testing, and to monitor systems in the field. BPPT-LSDE has been able to develop national standards for SHS. All proposed training activities for staff of BPTT-LSDE have also been successfully carried out, including an one-month training of about 5-6 people in Germany. Also as a direct result of the project's support, LSDE was awarded ISO 25 accreditation in June 2001 – which goes beyond the original TA that required only a plan to be prepared for obtaining accreditation. Currently, BPTT-LSDE is exploring opportunities for technical cooperation with other countries (i.e. Vietnam, Sri Lanka) through provision of training on system testing.

In addition, institutional strengthening services were extended by PSG to other stakeholders such as participating banks and dealers/suppliers. For participating banks, the focus was to familiarize them with the SHS technology, the market being targeted and how to handle loans for SHS vendors and isolated rural end-users. For SHS dealers/suppliers, particular attention was given to market and business development (e.g., business model development, business plan elaboration, training on marketing, etc).

5. Major Factors Affecting Implementation and Outcome

5.1 Factors outside the control of government or implementing agency:

The financial sector crisis blocked entry of PBs and SHS dealers into the project. In late 1997, when the project became effective, Indonesia was engulfed in a deepening economic and political crisis. To enter the project, dealers were required to have a loan from one of the PBs under the credit component. However, the near total paralysis of the financial sector largely blocked implementation of the credit component up to mid-2000. Two of the expected PBs were prevented by their financial situations from participating in the project, while the other two PBs were not able to issue fresh credits until their recapitalization was completed in May and June 2000. The SHS dealers were unable to borrow from the banks (only one dealer was able to meet conditions for credit approval by a PB in 2001), and they were unable to offer any significant credit to their customers.

Market collapse, weak business environment, depreciation and other factors reduced the attractiveness of investment in SHS business and reduced affordability of potential SHS end-users. The financial and economic downturn of 1997 also had a strong detrimental impact on the business environment. During the first two years of the project, commercial sales plummeted and the one successful dealer went out of business. At the same time, sharp depreciation of the Rupiah contributed to a significant increase in the retail prices of SHS units. At appraisal in September 1996, the Rupiah was valued at Rp. 2,341/US$; by January 1998, it had declined to Rp. 17,000/US$. Since then, the value of the Rupiah has slowly improved, remaining stable at around Rp. 8,500/US$ in 2003. However, the business environment and investor confidence continues to be weak, in response to local and international security concerns, local governance and judicial system issues, and concerns about political stability in advance of the 2004 elections.

Unprecedented decline in commodity prices reduced affordability of SHS in the target rural areas. The main sources of income for rural families in many of the project areas depend on coffee, cacao and oil palm. In 2001, international coffee prices reached their lowest level since 1973. Palm oil prices over 2000-2001 were roughly half those of 1998. Since then, international prices of these crops moved up sharply in 2002. However, producer prices in the project areas remained stable at low levels mainly because international increases have been offset by the Rupiah appreciation. Likewise, cacao farmers have benefited from improved prices over 2002-2003, but poor growing conditions have reduced production. Although low prices in the early years of project implementation have improved since then, overall commodity prices have declined reducing the affordability of SHS customers in many of the project areas.

5.2 Factors generally subject to government control:

Continuing subsidies for kerosene and diesel lowered the competitiveness of SHS. The price competitiveness of SHS in rural areas declined and then stayed at comparatively low levels during 1998-2001 as fuel and tariff subsidies were maintained for competing products, (for example, kerosene for lighting and diesel for operating a small genset). In comparison with the 400% increase (in rupiah terms) in the retail price of SHS, retail prices of kerosene and diesel up to early 2001 were only 40% and 58% higher than in 1997. However, SHS competitiveness increased as the government began to implement subsidy reduction policies in late 2000 for kerosene, diesel and electricity. By 2003, kerosene and diesel prices had been raised to Rp 900 and Rp. 1,650 per liter respectively, and additional increases have continued, with some postponements, on a regular basis, though the subsidies have not yet been fully removed.

Government/Donor funded programs. The competitiveness of commercial SHS has also been occasionally lowered in some areas by government or donor funded programs which supply SHS at nominal prices well below market prices, effectively crowding out commercial sales as people prefer to queue and wait for a gift than purchase the system based on market price.

5.3 Factors generally subject to implementing agency control:

BPPT established a Project Support Group (PSG) that provided effective services for business development, end user verifications, consumer satisfaction monitoring, monitoring of transparent grant releases, and reporting. It also undertook a number of unanticipated tasks, such as the study of development impacts, design and financial closing of credit enhancement mechanism for BRI loans to SHS customers, project level financial reporting and liaison among the World Bank, Ministry of Finance, and participating bank to ensure consistent recording of transactions.

5.4 Costs and financing:

The total project cost at appraisal was US$118.1 million, including the IBRD loan (US$20 million), the GEF grant (US$24.3 million), the local counterpart funding from GOI/BPPT (US$1.5 million), the

participating banks (US$5 million), and the participating SHS dealers and end users (US$67.3 million).

At the end of the project, actual project costs were US$8.95 million, only 7.6% of the original cost, mostly as the result of the low level of SHS units sold under the credit component. Conversely, the cost of the TA component was more in line with the original estimates, with actual costs for this component amounting to $4.36 million or 69% of the original estimate (US$6.3 million). The $8.95 million total project costs consisted of US$0.08 million of the Bank loan; US$4.52 million of GEF grant, US$0.59 million of GOI/BPPT contribution, US$0.06 million from the participating banks, and US$3.70 million from dealers/end-users.

Cancellations during the project significantly reduced the budgets available from the loan and grant. After the IBRD loan was canceled in January 2001, the GEF grant was reduced from the original amount of US$24.3 to US$11.0 million as part of the project alignment. In April 2003, the grant was further reduced to US$5.22 million in response to the diminishing opportunities for increased sales. As of April 30, 2004, $4.52 million of GEF grant has been disbursed.

6. Sustainability

6.1 Rationale for sustainability rating:

Project sustainability is rated likely because of the following factors:

(1) Broad business environment conditions are slowly recovering from the low levels of the 1997-99 crisis. Although the business environment is still weak, signs of improvements had emerged since 2000 and continued through 2003, including: (i) a stronger currency - the rupiah remained stable and stronger during 2003 as compared with 1997-2002; (ii) moderate inflation - inflation was reduced to 4.8% in 2003, compared with inflation of 10% in 2002, 12.5% in 2001 and a record high of 77% in 1998; (iii) falling interest rates; and (iv) relatively stable cash crop prices in 2003.

(2) SHS sales have continued in the project areas even after grant closing. Of the total 8,054 SHS sold under the project, 4,139 were sold in 2003 (51%), reflecting not only the intensive efforts by the dealers to increase sales before the grant closing, but also the increasing demand for SHS as result of the following factors: (i) increased competitiveness of SHS as subsidies continued to be lowered on competing products, especially kerosene (lighting), diesel (gensets) and electricity (battery charging); and (ii) increased Rupiah income of farmers growing export crops in Lampung and South Sulawesi. After grant payments to dealers were discontinued under the project as of September 30, 2003, a total of 427 SHS units were sold from September 30 to December 31, 2003 by the participating dealers. This sales momentum is expected to continue in 2004 and thereafter.

(3) Marketing, business and technical capabilities of SHS dealers have improved. During the last year of the project, substantial support was provided to SHS dealers to facilitate their transition to the post-project phase. Support was given to strengthen dealer's internal controls, and marketing, business and technical capabilities. Companies were assisted to link with commercial investors and funding sources, including the Solar Development Fund (SDF), which has now developed a client relationship with three of the dealers that participated in the project and established with BRI (a commercial bank with extensive service network in rural areas in Indonesia) a guarantee facility. As a result of the GEF support, considerable capacity has been built and a solid base for future SHS development has been established.

(4) **National quality standards and testing capabilities are in place**. National quality standards and certification procedures, domestic testing and certification capabilities to ISO 25 standards have been

established in the country. Quality certified products from several local suppliers at internationally competitive prices are also available. One of the qualified suppliers is becoming a major exporter of SHS components (such as lamps and controllers) on the basis of support provided and quality certifications awarded under the project.

(5) **Decrease in the real cost of PV modules and their installation cost**. Supply prices for photovoltaic panels continue to decline internationally, which will contribute to continuing retail price declines for SHS in Indonesia.

Nonetheless, this is a market-based project, and sustainability will be largely affected by market conditions and the overall business environment, including improvements in the frameworks for enforcing contracts and for transparency in official transactions, and unforeseeable security and political events.

6.2 Transition arrangement to regular operations:

A number of initiatives are underway which will assist the dealers in their transition to full commercial operation:

BRI - SDF guarantee facility for SHS credits. In early 2002, the PSG and several dealers started discussions with BRI on the establishment of a credit support facility for SHS. In early 2003, SDF joined the discussions. After long negotiations, a Memorandum of Understanding (MOU) between BRI and SDF for a guarantee facility for qualified SHS dealers was signed in March 2004. This BRI partial guarantee facility is a potentially significant step forward in addressing the consumer finance barrier. The facility will operate initially as a two-year pilot with a target of 1,500 customers located in the areas of South Sumatera, Riau, and South Sulawesi provinces. Funding for this facility is based on deposit accounts opened by the dealers and buyback guarantees issued by the dealers and SDF. The maximum loan amount that can be provided by BRI to the SHS consumers is Rp 3 million (about US$350 equivalent) per unit system, with a maximum loan maturity period of 24 months at interest rates set by BRI. When a consumer falls behind in his/her loan payments by up to two months, then BRI is authorized by the SHS company to automatically deduct from the guarantee fund the total balance of the consumer's obligation and at the same time, the company is automatically requested and entitled to de-install and claim the customer SHS unit. Given the extensive rural branch network of BRI (with more than 3,000 rural outlets), it is expected that the facility has a big potential for a breakthrough in providing access to consumer finance to SHS customers, a main barrier to PV market development in Indonesia.

Local governments starting to adopt market based approach to SHS subsidies. A long standing constraint in Indonesia has been the practice of local governments procuring SHS units which are then provided to households on a free or highly subsidized basis. Following discussions with the Bank June 2001 supervision mission of the experience in Uva Province in Sri Lanka, where the Uva provincial government has provided matching grants parallel to the grants from the Energy Services Delivery project with resulting increases in SHS sales, the PSG promoted a similar competitive market-based approach to such subsidies to local governments in the SHS Project areas. Although the local governments, in general, have not been willing to change from their practice of direct procurement, last year in Bengkulu an estimated 200 units were procured on the basis of a subsidy of $150, with the balance (approximately $200 - $300) to be paid by the consumer who decides to purchase the unit. This represents a positive a step towards the direction of a more market-based approach. Positive results from this experience are expected to contribute to similar approaches being adopted in additional areas.

Re-activation of Association of Indonesian SHS Dealers. Established in 1992 but reactivated in 2000, the Association's goals are to promote SHS business activities, provide advice to SHS dealers, and inform

the Government of SHS market opportunities. Eight companies are currently registered as members of this Association. The Association is currently working on establishing an accreditation system and setting minimum quality standards for SHS dealers. Future activities would include carrying out presentations to several governments agencies (i.e. Ministry of Environment, DGEEU, People Welfare Ministry) to promote renewable energy SHS business opportunities.

SHS pricing after removal of grant support. The dealer with the largest sales volume is currently planning a 10% increase in SHS prices after removal of grant support. This relatively small increase appears possible partly because this dealer has anticipated the removal of the grant support in its pricing over the past nine months, and secondly, the strengthening of the Rupiah together with international price declines for modules has lowered the supply costs of the systems.

7. Bank and Borrower Performance

Bank

7.1 Lending:

The Bank's performance during project identification, preparation and appraisal is considered highly satisfactory because of the reasons explained in Section 3.5 above. Furthermore, from the initial stages of project identification to Board approval, the Bank provided considerable assistance to the Borrower and Implementing Agencies in all aspects of the project.

7.2 Supervision:

Bank supervision was highly satisfactory throughout the project implementation. The performance of the Bank supervision team was notable in its commitment to focus on ultimate development effectiveness rather than merely the mechanical implementation of the project as initially designed. The project was restructured several times to respond to the changing market conditions, and to maximize its development impact and ensure that project objectives could be achieved, albeit, on smaller scale. Without these efforts, the project would most likely have been ended much earlier as a matter of routine portfolio clean up, which would have reduced the benefits achieved by the project up to date, most notably the technical and institutional capacity that has been built up in the country.

Field visits were carried out twice a year by the Bank team until project completion, including an intensive mid-term review in September 2000. The Bank team enjoyed continuity and an appropriate skill mix to suit the nature of the project. The supervision reporting was complete and candid in all aspects. The project stakeholders benefited from Bank technical assistance under supervision, and the relationship between the Government and the Bank on the project was open and effective throughout implementation.

In addition, project supervision was rated "Superior" by QAG's Second Rapid Supervision Assessment (RSA2) which assessed the quality of Bank's supervision in FY98. The project was reviewed again under the QAG's Fourth Supervision Assessment in FY2000 (QSA4), which rated project supervision as "highly satisfactory".

7.3 Overall Bank performance:

Overall Bank performance is rated highly satisfactory. Although the decision to close the grant four months earlier than planned and at the time when sales were going up could be questioned, there was an overall agreement between the Bank and the Borrower that carrying on the project for additional four months would only yield marginal benefits. It was clear that the project had already delivered its major accomplishments by mid-2003, and the foundations for further SHS market development in Indonesia were already in place.

It should be noted that the Bank's performance assessment is also rated highly satisfactory by the BPPT in their own evaluation report on behalf of the borrower.

Borrower

7.4 Preparation:

The Borrower's performance during project preparation is rated satisfactory. There was close cooperation at the time of preparation between the Government and the Bank, and the leadership and vision provided by the main counterparts in GOI ensured that the project was appropriate to Indonesia's needs. Representatives from all the counterpart agencies and private sector were involved in the preparation and implementation of the project. The Borrower was familiar with PV technology, given the Government's pilot solar PV demonstration programs beginning in 1987, and recognizing the heavy and recurrent subsidy burden associated with these programs, the GOI was also keen to support the objectives of the project.

7.5 Government implementation performance:

The performance of BPPT, the government implementing agency and main recipient of the technical assistance of the project is deemed satisfactory, as it was able to successfully meet (even exceed) the objectives it was directly responsible for. The performance of DGEEU, another government implementing agency, is rated unsatisfactory due to the protracted procurement delays and ultimate cancellation of the *Renewable Energy for Rural Transformation Study*.

7.6 Implementing Agency:

The performance of the Project Support Group (PSG) is considered highly satisfactory. It provided substantial support and effective monitoring of project performance throughout project implementation, and complete reporting through quarterly and annual progress reports of high quality. The PSG support was effective in verifying that: (i) the private dealers were using the funds provided to them under the project in accordance with the project design; (ii) the dealers were complying with the pre-designated technical, after-sales service and consumer protection standards; and (iii) that customers were satisfied with their SHS units. The PSG took a leading role in conceptualizing, motivating and managing the process of establishing the partial guarantee facility at BRI, and facilitating the resolution of the many issues that were raised among the parties during the gestation of the facility.

The performance of the private sector participants (dealers, banks), with the exception of Bank Niaga - the only active participating bank during project implementation- is considered unsatisfactory because of the slow progress of the SHS sales, weak investment in rural distribution networks and inability of the banks to make loans available to SHS dealers, although such was caused mainly by factors beyond their control, including the collapse of the banking sector, civil unrest and the sharp depreciation of Rupiah.

7.7 Overall Borrower performance:

The overall borrower performance is rated satisfactory.

8. Lessons Learned

A satisfactory business environment is necessary for success in a market development project. Project interventions can spark the interest of investors and provide some of the incentives for a commercially driven market framework, but success in a project that is based on implementation by market means requires a satisfactory business environment.

Market-based projects should provide broad scope for companies to adjust product lines and business models to meet changing market signals. The thrust of the changes and the eventual realignment of the project were to increase the scope and time for companies to adjust products and

business models in response to changing market conditions. The dealers responded with product lines that maintained affordability and a variety of revised business models in line with local capabilities and opportunities.

Both front-loaded and performance based grant support help induce retail market entry by for-profit companies for a variety of reasons. An upstream, cost-shared support helps to induce the market entry of dealers and assist them to develop retail distribution operations in remote rural areas where market entry costs are high by making the products more affordable to consumers, reducing risks to companies, and improving cash flows. This approach has been proven in Sri-Lanka, where a well-functioning market has now developed.

Project design should focus as much on profitability as on affordability. During project preparation, great attention should be paid to profitability. Determining the profit potential that will be necessary to induce the risk taking for investment and market development should be a factor in setting grant levels and timing – a factor as important as affordability and willingness and ability to pay.

Performance based grants for SHS sales in retail markets should scale down during implementation to facilitate transition of companies to commercial operations. The per Wp performance-based grant initially was to remain at the same level for the life of the project. While this arrangement may induce dealers to develop sales in the early years, it would not encourage companies to prepare themselves for transition to a fully commercial operation at the end of the project. The project realignment provided for a scaling down of the grant level over time, with some flexibility linked to the pace of market development.

A convincing end-user audit program and transparent grant releases encourages companies to participate in the project and follow the consumer protection requirements. A strong end-user audit facility, in addition to ensuring compliance with consumer protection requirements, assures that there will be fair competition among the companies. The arrangements for transparent grant releases minimize the time and transaction costs of the companies, minimize opportunities for corruption, and encourage dealers to focus their learning and marketing efforts on rural consumers, rather than on processing paperwork for grant payments.

Support to financial organizations is necessary to increase their knowledge of the market. The high costs of market entry that confront dealers are mirrored by the costs that confront organizations that would finance them, especially the high costs of information about the market and dealer performance in remote rural areas beyond the reach of the branch networks of Indonesia's financial institutions. Facilitating initial field visits and providing information on dealers and sales performance, much of which is generated as a by-product of the end-user audits, reduces the transaction costs of financial institutions, thus partially lowering a barrier to their financing of SHS dealers.

The household and institutional market segments should be targeted in an integrated way in order to achieve sustainable access and development impacts. The main emphasis of the project was originally on sales of SHS to rural households. The realigned project, with its shift to a per Wp grant basis, provided the basis for sales to health, education and community based institutions. This is an opportunity to expand sales and spread the development benefits to families that may not be able to afford to purchase an individual household unit.

Highly subsidized systems made available to consumers through government and donor supported programs can undercut market development based projects. Project arrangements should actively

promote the adoption of sustainable, market based approaches in government and donor SHS and PV projects, including competitive arrangements and community driven approaches.

A carefully designed socio-economic survey mechanism should be built in the SHS projects to assess the development impact. A development impact study was introduced during the project implementation. The study included three steps – baseline establishment, initial impact survey after six months of SHS installment, and follow up survey after one year of SHS installment. While the interval between the two impact survey steps appears to be short, the study produced positive and useful findings.

9. Partner Comments

(a) Borrower/implementing agency:
The borrower's report was received by the Bank on November 19, 2003 but not attached to the ICR because of the length. The borrower's report is available in the project files. The draft ICR was provided to the borrower and implementing agencies, who confirmed that they do not have any comments (see Annex 8).

(b) Cofinanciers:
None

(c) Other partners (NGOs/private sector):
None

10. Additional Information

Annex 1. Key Performance Indicators/Log Frame Matrix

Project Objective	Performance Indicators	Baseline Year (SAR-1996)	Target (SAR)	Revised Target (2001)	Actual (as of Sept 30, 2003)
A. Provide modern energy form of electricity, in an environmentally sustainable manner, to rural customers who cannot be served economically or in a timely manner by conventional rural electrification	**Outcome Indicators**				
	● Number of units sold per year on credit	4,000	about 55,000	about 34,000	about 1,610
	● Cumulative number of SHS units sold under Project	Not applicable	200,000	about 70,000	8,054
	● Customer timely payment rates	Not applicable	95%	95%	above 95%
	Impact Indicators				
	● Cumulative number of people served by SHS project*	Not applicable	880,000	350,000	35,438
	● Cumulative environmental benefits ('000 tons CO2 emissions abated)**	Not applicable	1,334	450	52.9
	● Cumulative fossil fuel conserved (kilo-liters)**	Not applicable	546,720	180,000	21,793
B. Establish private sector based efficient and sustainable delivery, financing, and loan collection mechanism for providing solar PV products to rural customers	**Outcome Indicators**				
	● Installed SHS Price (in constant 1996 dollars):				
	a) Java	a) $550 - $650	a) About $425	About $8 -10/Wp	$440
	b) off Java	b) $700 - $800	b) About $500 w/ GEF grant	without GEF grant	$490
	● Dealers with "problem loans"	Not applicable	2 or less	none	none
	Impact Indicators				
	● Number of dealers selling to households on credit basis.	2	5 or more	4 to 6	6
C. Capacity building of key sector institutions	**Outcome Indicators**				
	● Decentralized rural electrification strategy study	Not applicable	Completed	Completed	Canceled
	● Procurement of equipment for BPPT's laboratory	Not applicable	Completed	Completed	Completed
	● Attainment of ISO 25 status for BPPT's laboratory	Not applicable	Action plan adopted	Action plan adopted	Completed
	Impact Indicator				
	● GOI adoption of decentralized rural electrification strategy and action plan	Not applicable	Completed	Completed	Action plan canceled

* The cumulative number of people served by the project is derived by multiplying the number of SHS units sold by the average family size (4.4)

** Over 15 years. Source: GEF Project Document, Annex 3.1, December 1996

Note: HH expenditure data on purchases of kerosene show that households reduced their monthly kerosene consumption from 25.9 to 14.1 liters after purchase of SHS (or, savings of 11.8 liter/unit). Source: Development Impact Study in the Province of Lampung, September 2003

Annex 2. Project Costs and Financing

Project Costs by Component (in US$ million equivalent)

	Appraisal Estimate	Actual/Latest Estimate	Percentage of Appraisal
Component	US$ million	US$ million	
1. Credit Component	92.1	4.22	4.6
2. Technical Assistance	6.3	4.36	69.2
2.1 Implementation Support	4.1	3.76	91.7
2.2 Policy Support	1.2	0.00	0
2.3 Institutional Development	1.0	0.60	60
Base Cost	**98.4**	**8.58**	**8.7**
Duties and Taxes	9.8	0.37	
Price Contingencies (Credit component)	9.8		
Total Project Cost	**118.1**	**8.95**	**7.6**
Total Financing Required	**118.1**	**8.95**	**7.6**

Project Costs by Procurement Arrangements (Appraisal Estimate) (in US$ million equivalent)

	Procurement Method		
Expenditure Category	**Other 1/**	**N.B.F. 2/**	**Total Cost**
1. Credit Component	101.9	0.0	101.9
	(20)		(20)
	[20]		[20]
Taxes	0.00	9.8	9.8
Subtotal	**101.9**	**9.8**	**111.8**
	(20)		**(20)**
	[20]		**[20]**
2. Technical Assistance			
2.1 Implementation Support	4.1		4.1
	[3.1]		[3.1]
2.2 Policy Support	1.2	0.0	1.2
	[0.7]		[0.7]
2.3 Institutional Development	1.0	0.0	1.0
	[0.5]		[0.5]
Subtotal	**6.3**	**0.0**	**6.3**
	(0.0)		**(0.0)**
	[4.3]		**[4.3]**
Total	**108.2**	**9.8**	**118.1**
	(20.0)	**(0.0)**	**(20.0)**
	[24.3]	**[0.0]**	**[24.3]**

Terms in ( ) and [ ] are amounts financed by IBRD and GEF, respectively
1/ Goods and services to be procured by limited international bidding or established commercial practice.
2/ NBF : Not Bank Financed

Project Costs by Procurement Arrangements (Actual/Latest Estimate) (in US$ Million equivalent)

	Procurement Method		
Expenditure Category	**Other 1/**	**N.B.F. 2/**	**Total Cost**
1. Credit Component	4.22	0.0	4.22
	(0.08)		(0.08)
	[0.81]		[0.81]
Taxes	0.00	0.37	0.37
Subtotal	**4.22**	**0.37**	**4.59**
	(0.08)		**(0.08)**
	[0.81]		**[0.81]**
2. Technical Assistance			
2.1 Implementation Support	3.76		3.76
	[3.21]		[3.21]
2.2 Policy Support	0.00	0.0	0.00
	[0.0]		[0.00]
2.3 Institutional Development	0.60	0.0	0.60
	[0.50]		[0.50]
Subtotal	**4.36**	**0.0**	**4.36**
	(0.00)		**(0.00)**
	[3.71]		**[3.71]**
Total	**8.58**	**0.37**	**8.95**
	(0.08)	**(0.0)**	**(0.08)**
	[4.52]	**[0.0]**	**[4.52]**

Terms in ( ) and [ ] are amounts financed by IBRD and GEF, respectively
1/ Goods and services to be procured by limited international bidding or established commercial practice.
2/ NBF : Not Bank Financed

Project Financing by Component (in US$ million equivalent)

Component	Appraisal Estimate US$ million	Actual/Latest Estimate US$ million	Percentage of Appraisal
1. Credit Component	**111.8**	**4.59**	**4.1**
• IBRD	20.0	0.08	0.4
• GEF	20.0	0.81	4.1
• Participating Banks	5.0	0.06	1.2
• Subborrowers/Endusers	66.8	3.64	5.4
2. Technical Assistance			
2.1 Implementation Support	**4.10**	**3.76**	91.7
• GEF	3.10	3.21	103.5
• GOI/BPPT	0.50	0.49	98.0
• Subborrowers/Endusers	0.50	0.06	12.0
2.2 Policy Support	**1.20**	**0.00**	0.0
• GEF	0.70		
• GOI/DGEED	0.50		
2.3 Institutional Development	**1.00**	**0.60**	60.0
• GEF	0.50	0.50	100.0
• GOI/BPPT	0.50	0.10	20.0
Total	**118.1**	**8.95**	**7.6**
• **IBRD**	**20.0**	**0.08**	**0.4**
• **GEF**	**24.3**	**4.52**	**18.6**
• **GOI/BPPT**	**1.5**	**0.59**	**39.3**
• **Participating Banks**	**5.0**	**0.06**	**1.2**
• **Subborrowers/Endusers**	**67.3**	**3.70**	**5.5**
Total Financing Required	**118.1**	**8.95**	**7.6**

Note: Subborrowers are dealers, who will be providing equity and reinvested profits; end-users are the households, who will be providing the downpayments.

Annex 3. Economic Costs and Benefits

Economic Analysis at Appraisal

The SAR calculates an economic rate of return (ERR) of 11.6% without GEF benefits and 39% with GEF benefits. (Annex 4.2, page 1). Table 3.1 reproduces the SAR analysis.

Table 3.1 Economic Analysis in SAR

		NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	**per SAR**																				
2																					
3	**Costs**																				
4	Invesment costs	66.2	6.07	12.45	23.25	27.18	23.15														
5	Replacement costs	21.8		0.02	0.07	0.51	1.28	2.84	4.62	6.44	5.96	6.3	3.98	3.86	6.06	7.1	5.54	2.7	2.38	0.23	0.11
6	O&M costs	3.6	0.03	0.11	0.26	0.44	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.57	0.5	0.35	0.16
7	total costs	91.6	6.1	12.58	23.58	28.13	25.03	3.44	5.22	7.04	6.56	6.9	4.58	4.46	6.66	7.7	6.14	3.27	2.88	0.58	0.27
8																					
9	**Consumer expenditures**																				
10	down payments	12.5	0.81	2.36	4.38	5.35	4.63														
11	Monthly payments	54.8	1.19	4.15	9.7	16.29	20.77	17.81	12.26	5.67											
12	Replacement expenditures	21.8	0	0.02	0.07	0.51	1.28	2.84	4.62	6.44	5.96	6.3	3.98	3.86	6.06	7.1	5.54	2.7	2.38	0.23	0.11
13	O&M expenditures	3.6	0.03	0.11	0.26	0.44	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.57	0.5	0.35	0.16
14	Consumer subtotal	92.7	2.03	6.64	14.41	22.59	27.28	21.25	17.48	12.71	6.56	6.9	4.58	4.46	6.66	7.7	6.14	3.27	2.88	0.58	0.27
16	GEF grant	14.2	0.83	2.45	5	6.13	5.6														
17	**total benefits**	106.9	2.86	9.09	19.41	28.72	32.88	21.25	17.48	12.71	6.56	6.9	4.58	4.46	6.66	7.7	6.14	3.27	2.88	0.58	0.27
18																					
19	**net flows(with GEF)**	**15.3**	-3.24	-3.49	-4.17	0.59	7.85	17.81	12.26	5.67	0	0	0	0	0	0	0	0	0	0	0
20	ERR	**39.5%**																			
21																					
22	**net flows(without GEF)**	**1.1**	-4.07	-5.94	-9.17	-5.54	2.25	17.81	12.26	5.67	0	0	0	0	0	0	0	0	0	0	0
23	ERR	**11.6%**																			

According to the SAR (para 4.16), two types of benefits are taken into account in the economic benefit-cost analysis: (i) global environmental benefits and (ii) local benefits that accrue directly to households, which are given by the household's "willingness-to-pay". Global environmental benefits are calculated as per Bank Guidelines (Bank OP 10.04, Paragraph 8). Household benefits are calculated as "actual payments made by household" plus "consumer surplus." Because of difficulties in measuring consumer surplus, only the former are used. In this regard, the SAR notes that "estimates of benefits were biased downwards because of the exclusion of the consumer's surplus from the benefits"

As shown in Table 3.2, this definition of net economic benefit stream (before GEF contribution) is equivalent to the following formula: monthly installment expenditures by customers (a financial cost) plus down payments by customers(a financial cost) minus SHS investment costs (presumably an economic cost)

This approach has problems, because the monthly installment payments by consumers are **financial costs** (whose magnitude is determined by the financial rate of interest charged by the financial institutions). Indeed, if the financial rate of interest were exactly equal to the discount rate, then the result of the above calculation is an NPV of zero and an IRR equal to the discount rate.[1]

Table 3.2 Restatement of SAR Analysis

	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Investment costs	-66.2	-6.07	-12.45	-23.25	-27.18	-23.15														
monthly expenditures	54.8	1.19	4.15	9.7	16.29	20.77	17.81	12.26	5.67											
down payments	12.5	0.81	2.36	4.38	5.35	4.63	0	0	0											
"net benefits, no GEF"	1.1	-4.07	-5.94	-9.17	-5.54	2.25	17.81	12.26	5.67	0	0	0	0	0	0	0	0	0	0	0
ERR	11.6%																			
GEF grant		0.83	2.45	5	6.13	5.6	0	0	0											
net benefits, with GEF"	15.3	-3.24	-3.49	-4.17	0.59	7.85	17.81	12.26	5.67	0	0	0	0	0	0	0	0	0	0	0
ERR	39.5%																			

According to this calculation, the computed "ERR" is exactly equal to the weighted financial rate of interest (which was evidently taken in 1996 at the time of the SAR, as 11.6%). The NPV of this payment stream represents the magnitude of the transfer payment from consumers to financial institutions (i.e. the difference between the capital cost at the opportunity cost of capital, and the financial payments actually made by consumers at the financial rate of interest). In short, the problem in the SAR approach is the inter-mixing of economic and financial costs without the necessary reconciliation.

Annex 3 of the IBRD-ICR repeats the same format of calculation, as shown in Table 3.3, though for a much smaller number of SHS actually implemented in 1999 and 2000. An ERR could not be calculated because this format contains only years with net benefits, but not years with net annual costs. However, the NPV remains as before, equal to the value of the transfer payment from consumers to the financial institutions as a consequence of the financial rate of interest being higher than the discount rate (of 10%).

Table 3.3 IBRD ICR Analysis

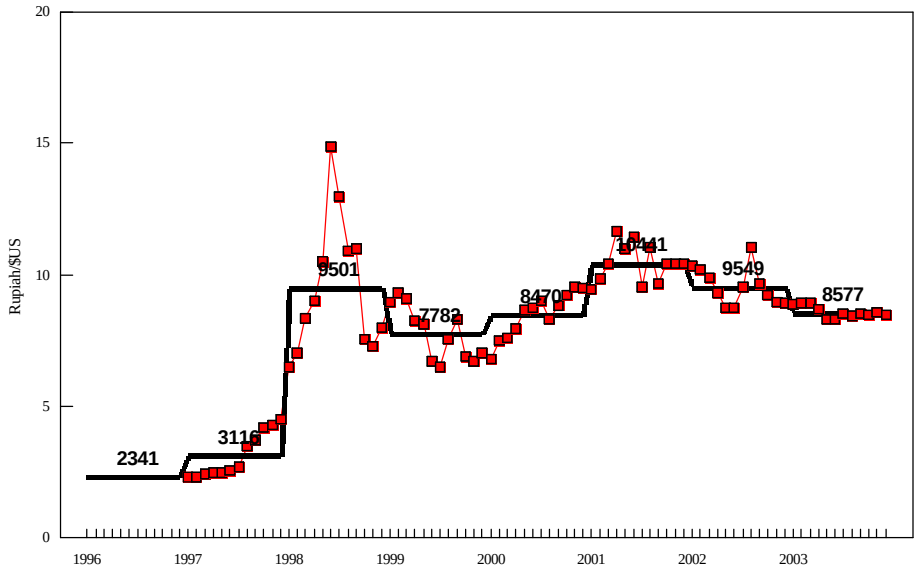
	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Costs																	
Invesment costs	0.7	0.05	0.76														
Replacement costs	0.2		0.000	0.003	0.007	0.059	0.009	0.093	0.059	0.003	0.007	0.066	0.089	0.007	0.059	0.003	0.002
O&M costs	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
total costs	0.9	0.050	0.760	0.003	0.007	0.060	0.009	0.093	0.060	0.003	0.007	0.066	0.089	0.007	0.060	0.003	0.003
Consumer expenditures																	
down payments	0.1	0.01	0.17														
Monthly payments	2.6	0.13	2.65	0.39													
Replacement expenditures	0.2	0	0.0002	0.0026	0.0067	0.0594	0.0088	0.0932	0.0594	0.0026	0.0067	0.0656	0.0892	0.0067	0.0594	0.0026	0.0024
O&M expenditures	0.0	0.0001	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Consumer subtotal	3.0	0.1401	2.8204	0.3928	0.0069	0.0596	0.009	0.0934	0.0596	0.0028	0.0069	0.0658	0.0894	0.0069	0.0596	0.0028	0.0026
GEF grant	0.1	0.01	0.13														
total benefits	3.1	0.1501	2.9504	0.3928	0.0069	0.0596	0.009	0.0934	0.0596	0.0028	0.0069	0.0658	0.0894	0.0069	0.0596	0.0028	0.0026
net flows(with GEF)	**2.2**	0.1	2.19	0.39	0	0	0	0	0	0	0	0	0	0	0	0	0
ERR	**Not calculated**																
net flows(without GEF)	**2.1**	0.09	2.06	0.39	0	0	0	0	0	0	0	0	0	0	0	0	0
ERR	**Not calculated**																

Issues in the Economic analysis

The economic disruptions during the implementation of the project also created difficulties for economic analysis, as the important indicators exhibited great volatility, with local prices shifting very rapidly, not

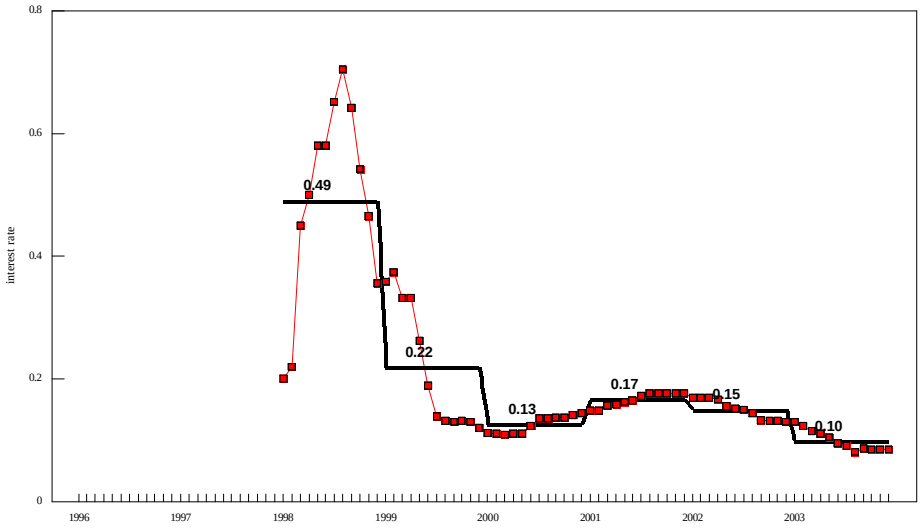
just during the initial period of Rupiah collapse, but in the subsequent years as well. Figure 1 shows the exchange rate, which stood at 2,341Rs/$US at the time of appraisal in 1996, reached a peak of 15,400 in June 1998, dropped to an average of 7,500 in 1999, and stood at around Rp8,500/$US in 2003.

Figure 1: Exchange rate: Monthly (annual) averages Rp:$US



Domestic interest rates show the same variation (Figure 2), which is a particular problem for the economic analysis methodology used in the SAR, since its economic benefits are dependant upon the financial rate of interest

Figure 2: Rp interest rates: SBI 1-month rate



The attractiveness of SHS, and its economic analysis, will be strongly influenced by the relative changes in the capital cost of the SHS, and the price of kerosene. The problem faced by the project in generating

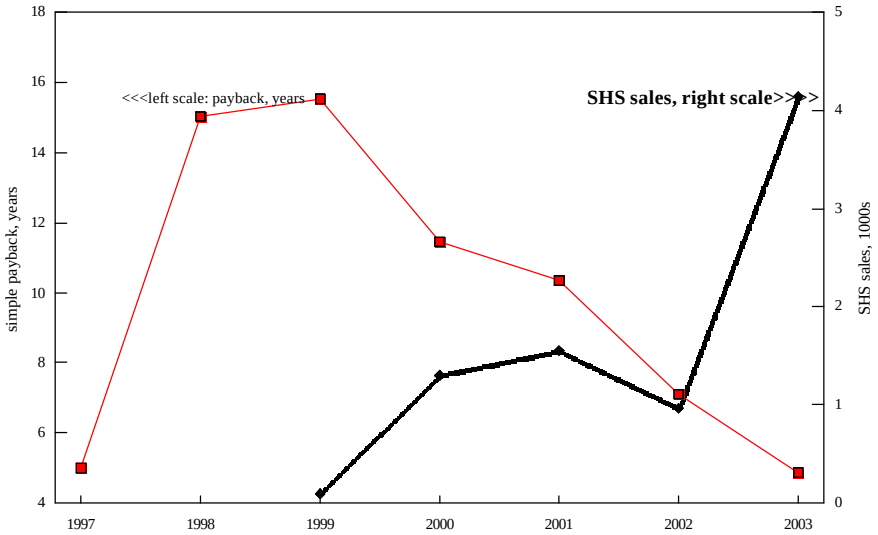
consumer interest in SHS sales is illustrated in Table 3.4. In 1997 the capital cost of one SHS unit was 5 times the cost of a typical annual energy bill (for kerosene, dry cells and battery charging). In 1998 and 1999, this cost rose to 15 times, before gradually declining, reaching 4.9 in 2003. As one might expect, the sales of SHS increased sharply in 2003, as the retail cost of kerosene increased by 50%.

Table 3.4: SHS sales v. household energy bill

		1997	1998	1999	2000	2001	2002	2003
SHS cost	Rp	1000000	3000000	3100000	3200000	3300000	3400000	3500000
Kerosene price	Rp/litre	250	250	250	350	400	600	900
exchange rate	Rp/$US	3116	9501	7782	8470	10411	9549	8577
Kerosene price	UScents/litre	0.08	0.03	0.03	0.04	0.04	0.06	0.10
HHkerosene bill (1)	Rp/year	75000	75000	75000	105000	120000	180000	270000
Estimated energy expenditure (2)	Rp/year	199500	199500	199500	279300	319200	478800	720000
Simple payback	years	5.0	15.0	15.5	11.5	10.3	7.1	4.9
SHS	sales			92	1299	1552	972	4139

(1) based on 2003 survey data of average monthly consumption of 25 liters. There is evidence that in 1998-2000 households reduced their consumption of kerosene as income decreased following the economic disruption of 1998/1998 – this would make the paybacks even greater.
(2) 2003 based on actual survey data. Values in 1997-2002 scaled to the ratio of kerosene expenditure to total expenditure in 2003.

Figure 3: SHS sales v. estimated payback (of annual energy bill)



The SHS Final Report[2/] presents an alternative way of expressing the affordability of a SHS unit by comparing with the quantities of major crops produced in the project areas, and that would need to be sold in order to equal the capital cost of an SHS: this calculation reflects the huge shifts in exchange rates and terms of trade that have occurred since 1997. By 2003, the affordability of SHS, in terms of both palm oil and cacao, returned to the conditions that prevailed at the time of project appraisal; however, the decline of international coffee prices – rather than adjustments in Indonesia – explains the sharp deterioration of SHS in terms of coffee trade. On balance, however, the Final Report concludes that the affordability conditions have generally returned to those expected at appraisal, particularly when combined with the reduction in

kerosene subsidy – and hence the sharp rise in SHS sales in 2003.

Table 3.5: Kg of major crops equivalent to one SHS

Years	Palm oil	Coffee	Cacao
1997 *	8,930	423	493
1998	10,158	220	281
1999	8,497	393	392
2000	13,770	1,018	545
2001	11,443	1,160	499
2002	9,127	1,262	432
2003	8,122	901	357

A rigorous framework for analysis

There are two rigorous methods that can be used to capture economic benefits: (i) avoided costs: i.e. benefits are taken as the avoided *economic* costs of kerosene, candles, dry cells and battery charging; and (ii) *change in consumer surplus*: benefits are taken as the change in consumer surplus (i.e. for both the with and without SHS case, the consumer surplus is calculated as the area under the demand curve less costs: the net benefit is the resulting *change* in consumer surplus).

The "avoided cost" method is easily applied because the information required can be provided by surveys of existing households, and the resulting calculations are straightforward. However, for two reasons this method generally underestimates the actual benefits:

- **First**, the quality of energy supply from SHS is superior to that from most alternative devices: for example, the illumination derived from a compact fluorescent lamp (CFL) is much higher than that provided by candles or kerosene lamp (in addition to avoiding many of the harmful side-effects such as smoke and odor, and the risk of fire and injury). Consumers are prepared to pay more for a better quality of service, for example they value a given number of lumens from solar-based electricity generation much more than the equivalent number of lumens from candles and kerosene. In other words, the benefits are greater than those inferred from replacement costs alone.

- **Second**, the demand curve for electricity (or an equivalent service, such as lighting, or TV-viewing), is not flat. It is well established that consumers are prepared to pay very high prices for the first few kWh of electricity (or lumens), sufficient, for one or two Cols. They are also prepared to pay high prices for enough electricity to power a TV. But the amount they are prepared to pay for the 10th and 11th CFL will be much less than the first and second CFL. This demand curve – of quantity demanded as a function of price -- is therefore downward sloping, and the total benefits from level of consumption is given by the area under the demand curve (to that point).

The second or the consumer surplus (CS) approach to calculating benefits requires estimation of such a demand curve. This is generally more difficult, because there may be few actual data points available to accurately determine the *shape* of the curve. But despite the additional uncertainty, this method of estimating the demand curve and the formalization of willingness-to-pay (WTP) is generally accepted as a better measure of the benefits of electrification. The CS approach has been used in several recent World Bank studies of off-grid electrification projects, including, in 2002, the economic analysis of the SHS component of the Philippines Rural Energy Project (SHS)[3], the 2003 ICR for the Sri Lanka Energy

Services Delivery Project (SHS and village hydro) [4], the 2003 Bolivia project (SHS) [5], and the 2003 study of off-grid commune-scale hydro systems in the SEIER project in Vietnam [6].

Re-estimation of the SAR Results: Avoided Cost

Table 3.6 shows the ERR and NPV, for a single system in Java, using the avoided cost method.

Table 3.6: Benefits at avoided costs (of kerosene replacement)

	NPV	1	2	3	4	5	6	7	8	9	10
SHS Costs											
Investment costs	636	636									
Replacement & O&M costs	304		40	40	40	40	40	40	40	40	40
total costs	940	636	40	40	40	40	40	40	40	40	40
Benefits (avoided costs)											
Kerosene expenditures (at economic prices)	867		114	114	114	114	114	114	114	114	114
total avoided costs	867	0	114	114	114	114	114	114	114	114	114
net flows(without GEF)	-66.5	-636	74	74	74	74	74	74	74	74	74
ERR	7.9%										
GEF grant	73	73									
total benefits	940	73	114	114	114	114	114	114	114	114	114
net flows(with GEF)	-0.1	-563.0	74.0	74.0	74.0	74.0	74.0	74.0	74.0	74.0	74.0
ERR	10.0%										

Note: calculations done (in spreadsheet) for 16 years: we show just the first 10 for clarity

Thus we note that the *economic* rate of return, when benefits are taken as avoided costs (of kerosene), is 7.9%, which is below the hurdle rate of 10%. The incremental contribution from GEF (73$) then brings the ERR to *exactly 10%*. This is, of course, the standard calculation presented in the SAR for GEF incremental costs [7]. The $73 GEF contribution shown here is exactly as calculated in the SAR [8].

ICR re-estimation: avoided cost

As noted above, the methodology used in the IBRD-ICR economic analysis made impossible to calculate the ERR. However, it is in all cases possible to estimate an ERR for a single system, whose first-period cash flow is negative, followed by some number of years of positive flow. In the calculation that follows, we present an estimate of the ERR at 2003 price levels: this has the benefit of assumptions based on the results of the detailed impact survey.

Assumptions

The average 2003 economic price of kerosene (as the average of the monthly Platts Singapore averages) is $33/bbl (Table 9). The official domestic price for household kerosene is Rp700/litre (effective 1/1/2003), while the general kerosene price was Rp1,800 (effective 17/12/2003), compared to the domestic gasoline price of Rp1,810/litre, almost the same as the international price. The domestic base price for household kerosene remains heavily subsidized.

Table 3.7 Kerosene prices

		$/bbl	Rp/litre	UScents/litre
[1]	international price	33	1780	20.8
[2]	domestic price		1800	21.0
[3]	household price		700	8.2
[4]	Reported average selling price in Lampung *		2640	30.8
[5]	transport differential		1940	22.6
[6]	Adjusted for SCF		1746	20.4
[7]	Economic price in rural area [1] + [6]		3526	41.1
[8]	Subsidy [7]-[4]		886	10.3

Average 2003 Exchange rate: Rp 8,577/$US
* see Table 3.8

However, over the last six months, Singapore kerosene prices have climbed significantly, as world crude prices (but only in US dollar terms) have climbed upwards. By late 2003 the kerosene price was 38$/bbl, and in the first quarter of 2004, prices have been as high as $42/bbl.

Table 3.8 shows average monthly expenditures before and after installation of SHS. The "before SHS" condition relates to 2000-2001, since the bulk of the systems were purchased in 2002 and 2003. Kerosene expenditure has dropped from 40,254Rp/month to 16,6671Rp/month (while the reported purchase price of kerosene has increased from 1,555Rp/litre to 2,638 Rp/litre, following the decrease in Government subsidy)[9]

Table 3.8: Average monthly energy expenditures, 2003

		before SHS	After SHS
Kerosene consumption	liters/month	25.88	6.32
Kerosene expenditure	Rp/month	40254	16671
Dry Cells	Rp/month	8140	5819
Battery Charging	Rp/month	11657	4653
total expenditure	Rp/month	60051	27143
average reported buying price for kerosene	Rp/litre	1555	2638

Source: Lampung SHS Survey, 2003

Table 3.9 shows a breakdown of total program sales by type of consumer finance: only 453 (5%) were cash sales, the bulk of the remainder were financed over 2 to 3 years with 20% or 30% down payments. For the representative system we chose the terms offered by dealer A: 20% down payment, and two year financing at 24% interest

Table 3.9 Consumer financing terms

DEALER	Down payment	INTEREST (Flat Rate)	CREDIT TERM (months)					Cash sales	TOTAL SALES
			12	18	24	30	36		
A	20%	24%	-	-	2,594	-	-	155	2,749
B	30%	24%	-	-	945	2,034	-	178	3,157
C	20%	18%	-	-	-	-	1,224	73	1,297
D	30%	18%	-	373	-	-	-	22	395
E	30%	22%	-	-	430	-	-	26	456
	TOTAL		-	373	3,970	2,034	1,224	453	8,054

With these assumptions the financial rate of return to the household installing a SHS unit is shown in Table 3.10. The FRR is 14.6%, which is above the discount rate, though perhaps still somewhat lower than the discount rate typical of rural households. However, there remain substantial subsidies on kerosene, and the FRR would be significantly higher if this subsidy were further reduced. This relatively high FIRR explains the sharp increase in SHS sales in 2003. However, at present levels of kerosene subsidy, and the difficulties of obtaining consumer credit, the market penetration of SHS will remain modest without further government support.

Table 3.10 Financial rate of return to households purchasing a SHS (in $US)

		NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
SHS Costs																		
Net cost to consumer		360	396.4															
amount financed		354	317															
Downpayment	20%	72	79.3															
repayments	24%	343	0.0	217.7	217.7													
Replacement & O&M costs																		
Controller		36	0.0						43.4					43.4				
Batteries		54	0.0				31.9			31.9			31.9			31.9		
Lamps		9	0.0	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Fixtures		4	0.0						5.2					5.2				
O&M costs		6	0.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
total O&M costs		110	0.0	2.2	2.2	2.2	34.0	2.2	50.7	34.0	2.2	2.2	34.0	50.7	2.2	34.0	2.2	2.2
total costs		525	79.3	219.9	219.9	2.2	34.0	2.2	50.7	34.0	2.2	2.2	34.0	50.7	2.2	34.0	2.2	2.2
Benefits (avoided costs)																		
official price	[Rp/litre]			*700*	*700*	*700*	*700*	*700*	*700*	*700*	*700*	*700*	*700*	*700*	*700*	*700*	*700*	*700*
transport differential	[Rp/litre]			*1940*	*1940*	*1940*	*1940*	*1940*	*1940*	*1940*	*1940*	*1940*	*1940*	*1940*	*1940*	*1940*	*1940*	*1940*
retail kerosene price	[Rp/litre]			*2640*	*2640*	*2640*	*2640*	*2640*	*2640*	*2640*	*2640*	*2640*	*2640*	*2640*	*2640*	*2640*	*2640*	*2640*
avoided kerosene	[litres/month]			*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*	*20*
avoided costs																		
kerosene		516	0	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75
drycell		23	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
battery charging		69	0	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
total avoided costs		608	0	88	88	88	88	88	88	88	88	88	88	88	88	88	88	88
net flows		83	-79	-132	-132	86	54	86	37	54	86	86	54	37	86	54	86	86
FRR		**14.6%**																

Table 3.11 shows the corresponding economic analysis, for which the basis is the economic cost of kerosene[10]. The ERR is 24.1% before the GEF benefit, 32.7% with the GEF benefit

Table 3.11: Economic analysis, benefits at replacement cost (in constant 2003 US$)

		NPV	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SHS Costs																		
Consumer price	**Rp**		3400000															
	$US	360	396															
. . less sales tax		33	36															
ex-dealer cost		328	360															
GEF subsidy		91	100															
effective cost		419	460															
of which																		
imported panel	0.600	251	276															
duty on imported panel	0.030	13	14															
balance of system(BOS)	0.300	126	138															
SCF for BOS	0.030	13	14															
installation	0.030	13	14															
dealer margin	0.010	4	5															
economic cost		389	428															
O&M cost adjusted for SCF		99	0	2.0	2.0	2.0	30.6	2.0	45.6	30.6	2.0	2.0	30.6	45.6	2.0	30.6	2.0	2.0
Benefits (avoided costs)																		
kerosene@border price		402	0	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
transport		342	0	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49
avoided dry cell expenditures		20	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
avoided battery charging expenditures		62	0	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
total avoided costs		825	0	119	119	119	119	119	119	119	119	119	119	119	119	119	119	119
net flows(without GEF)		338	-428	117	117	117	89	117	74	89	117	117	89	74	117	89	117	117
ERR		**24.1%**																
GEF grant		91	100															
net flows(with GEF)		429	-328.2	117.4	117.4	117.4	88.8	117.4	73.8	88.8	117.4	117.4	88.8	73.8	117.4	88.8	117.4	117.4
ERR		**32.7%**																

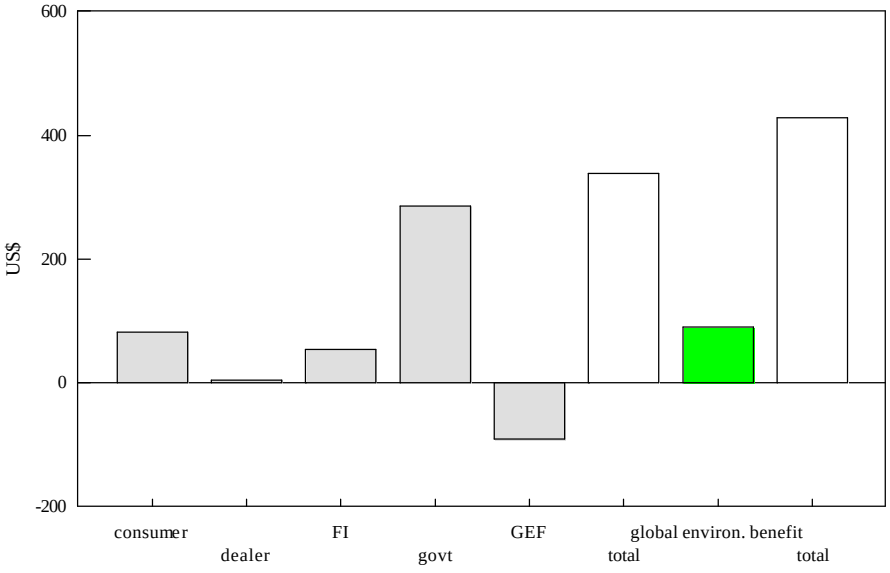
Table 3.12 shows the reconciliation of economic and financial flows. The *columns* of this table represent the stakeholders, while the *rows* of the table represent the individual transactions. Column 6 represents the economic benefits, in which taxes, duties and transfer payments cancel out (e.g. the GEF grant is paid by GEF to the dealers, and represents a transfer payment; the economic benefit of carbon emissions is assumed to equal GEF's willingness-to-pay, and is then added as a environmental benefit in column 7). Similarly the financing transactions involving the financial institutions and consumers (representing down payments and monthly repayments) have no impact on the *economic* accounts, but do show a gain to the financial institutions, a reflection of the fact that the financial rate of interest (24%) exceeds the discount rate(10%)

Table 3.12: Reconciliation of economic and financial flows (as NPV at 10%, constant 2003 US$): Single household with SHS

	consumer	dealer	FI	govt	GEF	total	global environ. benefit	total
downpayment	-72	72				0		0
amount financed		288	-288			0		0
monthly repayments	-343		343			0		0
panel		-251				-251		-251
balance of system		-138		13		-126		-126
installation		-13				-13		-13
import duty on PV panel		-13		13		0		0
sales tax on SHS		-33		33		0		0
replacement& O&M costs	-110			11		-99		-99
avoided costs[=benefits]								
kerosene (incl.transport)	516			227		743		743
dry cells	23			-2		20		20
battery charging	69			-7		62		62
GEF grant		91			-91	0		0
environmental benefit						0	91	91
	83	4	55	287	-91	338	91	429
returns	14.6%					24.1%		32.7%
	(=FRR to consumer)					(=ERR)		(=ERR with global benefit)

It is clear from this table (and Figure 4) that government is the biggest beneficiary of the SHS, because it avoids the substantial kerosene subsidy (while the financial benefit to consumers, as noted above, is modest).

Figure 4: Winners and losers (as NPV at 10%, constant 2003 $US): Single household with SHS

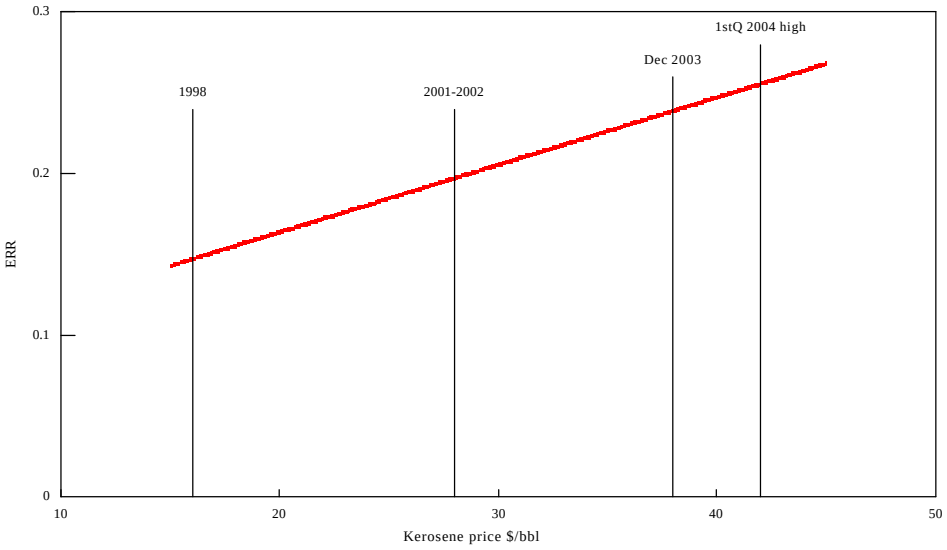


However, it should be noted that the decline in kerosene subsidy does not, in itself, significantly change the

economic benefit of a given SHS, because whether the government pays the cost of kerosene, or the consumer, the same quantity of kerosene is replaced by a given SHS (and the country benefits by the reduction in border cost of kerosene). It only changes (in a static analysis) the *distribution* of costs and benefits: the higher the retail kerosene price, the lower the subsidy (so Govt. gains); but also the higher the kerosene price, the greater is the incentive for consumers to purchase a SHS, so the main *economic* effect of a reduction in kerosene subsidy is a larger number of systems installed (other things equal) -- which increases the NPV, but does not (significantly) change the ERR. Thus the decrease in kerosene subsidy has improved the *financial* returns to households that install SHS.

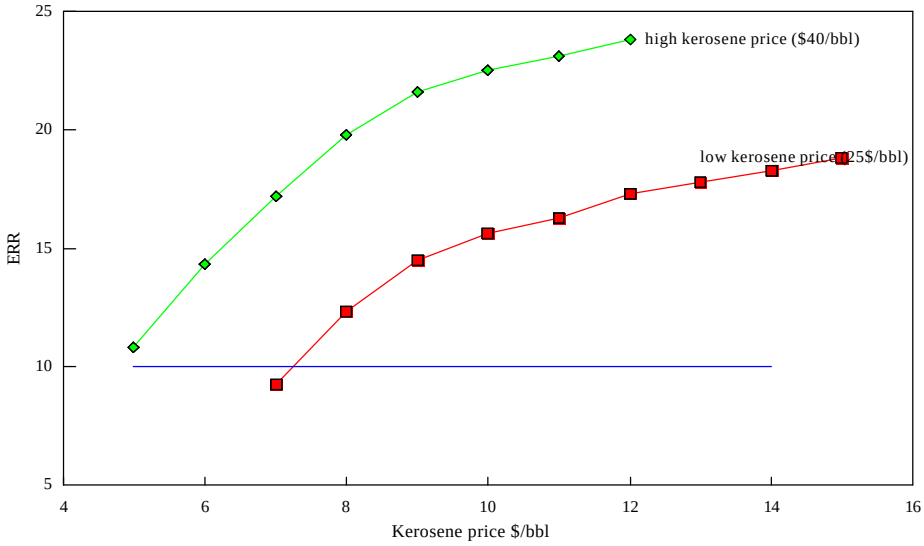
The relationship of ERR to the kerosene price is illustrated by the sensitivity analysis of Figure 5. As the kerosene price has increased over the past five years, the ERR has also increased. We note that the switching value for kerosene price (i.e. at which the ERR exactly equals the 10% discount rate) is an unlikely $8/bbl, far below the price in late 1998 when (for a few months) Brent Crude traded at $10/bbl.

Figure 5: Sensitivity analysis to the border price of Kerosene



The other significant uncertainty is the lifetime of the system, assumed at 15 years for the base case. Figure 6 shows the sensitivity of ERR to this assumption, for high ($40/bbl) and low (25$/bbl) kerosene border prices. The curves are not smooth because of the aperiodic major outlays for battery and controller replacement. The switching values range from 7 years for the low kerosene price to less than 5 years for a high kerosene price. The experience in other countries shows that the vast majority of systems have at least a 10 year life (few systems have been in place for much longer), so the economic returns may be regarded as robust. In any event, consumer surplus based ERRs are several percentage points higher, implying even lower system lifetime switching values.

Figure 6: Sensitivity to system life



The NPV for the entire programme (see Table 3.13) is $2.06million (before GEF) and $2.62 (with GEF benefit).

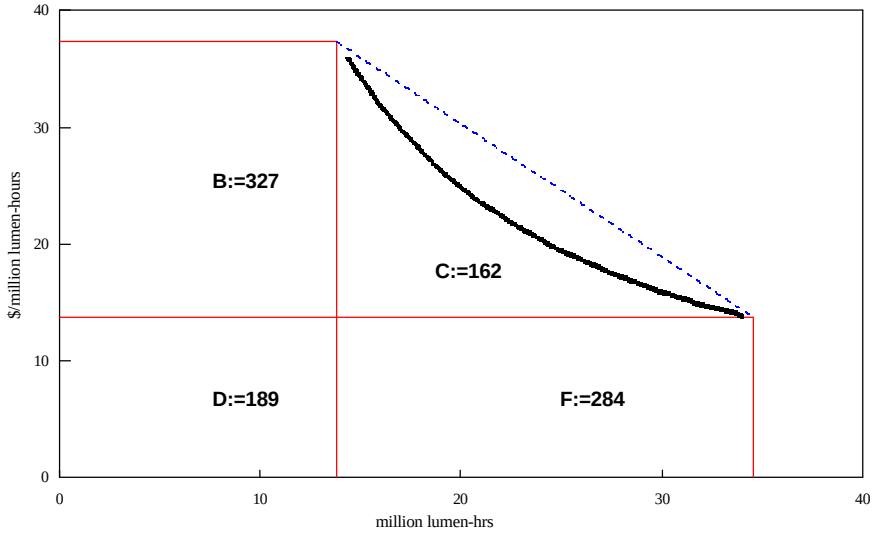
Table 3.13: Aggregate results (1000 $US)

			NPV	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
		[#]		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Economic flows, before GEF grant																							
SHS installed in	1999	92	31	-39	11	11	11	8	11	7	8	11	11	8	7	11	8	11	11				
	2000	1299	399		-556	152	152	152	116	152	96	116	152	152	116	96	152	116	152	152			
	2001	1552	433			-664	182	182	182	138	182	115	138	182	182	138	115	182	138	182	182		
	2002	972	247				-416	114	114	114	86	114	72	86	114	114	86	72	114	86	114	114	
	2003	4139	955					-1772	486	486	486	368	486	307	368	486	486	368	307	486	368	486	486
total flows			2064	-39	-545	-501	-71	-1315	908	897	858	724	859	736	787	845	848	749	722	906	664	600	486
ERR			24.1%																				
Economic flows, with GEF grant																							
SHS installed in	1999	92	39	-30	11	11	11	8	11	7	8	11	11	8	7	11	8	11	11	0	0	0	0
	2000	1299	506		-426	152	152	152	116	152	96	116	152	152	116	96	152	116	152	152			
	2001	1552	550			-509	182	182	182	138	182	115	138	182	182	138	115	182	138	182	182		
	2002	972	313				-319	114	114	114	86	114	72	86	114	114	86	72	114	86	114	114	
	2003	4139	1212					-1358	486	486	486	368	486	307	368	486	486	368	307	486	368	486	486
total flows			2620	-30	-415	-346	26	-902	908	897	858	724	859	736	787	845	848	749	722	906	664	600	486
ERR			32.7%																				

ICR re-estimation: benefits as changes in consumer surplus

Demand curves for lighting (as lumen-hours), and for TV/Radio/VCR listening-hours were derived using the methodology described in Attachment 1. Figure 7 shows the demand curve for lighting: the y-axis represents $ per million-lumen hours. The change in consumer surplus is then calculated as the areas B+C in Figure 7: these are calculated as NPVs over the 15-year life, with details shown in Table 3.15.

Figure 7: Demand curve for lighting



In the case of the corresponding demand curve for listening hours, the increase in listening hours is based on the survey data shown in Table 3.14 (increasing from 7 to 9.5 hours). This increase is much smaller than observed in other countries: in the Philippines, the corresponding listening hours increased from less than 1 hour to four hours per day.

Table 3.14: Daily usage hours

	Before SHS	After SHS
TV BW	3.0	3.1
Tape recorder	2.0	1.6
Radio	2.0	3.1
VCD		1.6
	7.0	9.4

Source: Lampung Survey, *op.cit.*,Table 4.53

Using the changes in consumer surplus as the benefits, the ERR increases from 24.1% (before GEF) to 30.6%, and from 32.7% (with GEF benefit) to 40.9%. (Table 3.15)

Table 3.15: Economic benefits as changes in consumer surplus

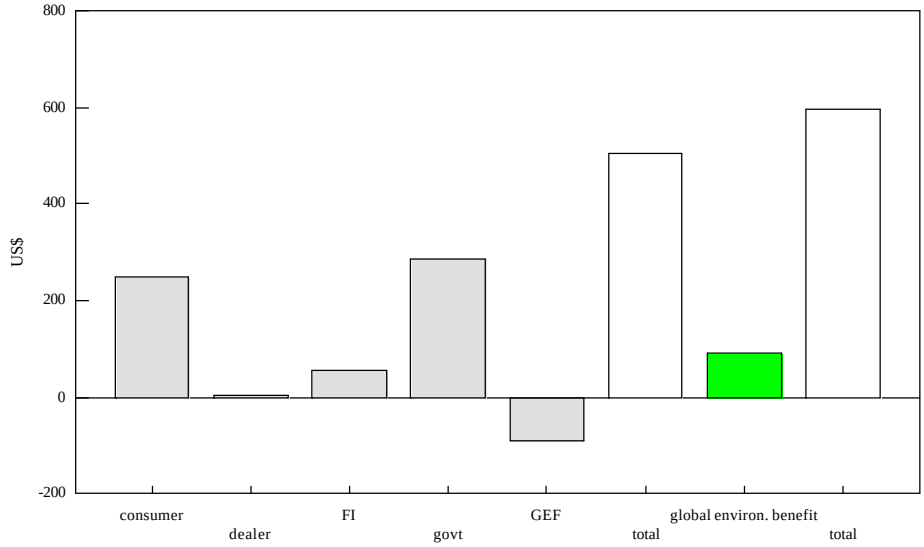
	NPV	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Lighting																	
allocated costs	473	71.4	197.9	197.9	2.0	30.6	2.0	45.6	30.6	2.0	2.0	30.6	45.6	2.0	30.6	2.0	2.0
levelised	473	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4
lumen-hours [Qpv]	34.6		5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
P[PV][$/million lumen-hrs]	13.7																
area D+E	473																
avoided kerosene costs	516	0.0	74.7	74.7	74.7	74.7	74.7	74.7	74.7	74.7	74.7	74.7	74.7	74.7	74.7	74.7	74.7
lumen-hours [Qkero]	13.8		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
P[KERO][$/mill lumen-hrs]	37																
area B+D	516																
TV/RadioListening																	
allocated costs	53	7.9	22.0	22.0	0.2	3.4	0.2	5.1	3.4	0.2	0.2	3.4	5.1	0.2	3.4	0.2	0.2
levelised	53	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
TV-hours [9.4]	23724		3431	3431	3431	3431	3431	3431	3431	3431	3431	3431	3431	3431	3431	3431	3431
P[PV]	0.002																
area D+E	53																
avoided costs																	
drycells+battery charging	91	0.0	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
TV-hours [7]	17667		2555	2555	2555	2555	2555	2555	2555	2555	2555	2555	2555	2555	2555	2555	2555
P[KERO]	0.005																
area B+D	91																
net financial flow to consumer	83	-79.3	-132.0	-132.0	85.7	53.9	85.7	37.2	53.9	85.7	85.7	53.9	37.2	85.7	53.9	85.7	85.7
additional CS benefits	168		24	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3	24.3
net flows [to consumer]	251	-79.3	-107.7	-107.7	110.0	78.1	110.0	61.5	78.1	110.0	110.0	78.1	61.5	110.0	78.1	110.0	110.0
ERR [to consumer]	**24.0%**																
Govt, sales tax, duties	58	63.7															
Dealer	4	4.6															
Fis	55	-317.1	217.7	217.7													
GEF	-91	-100.0															
Govt	229		33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1	33.1
Total	506	-428.2	143.1	143.1	143.1	111.2	143.1	94.6	111.2	143.1	143.1	111.2	94.6	143.1	111.2	143.1	143.1
ERR	**30.6%**																
net flows with GEF	597	-328.2	143.1	143.1	143.1	111.2	143.1	94.6	111.2	143.1	143.1	111.2	94.6	143.1	111.2	143.1	143.1
ERR	**40.9%**																

The corresponding reconciliation of economic and financial flows is shown in Table 3.16. The entries for the stakeholders other than consumers are the same as before (compare to Table 3.12), but the economic benefits for consumers, and the corresponding totals, now reflect the change in consumer surplus.

Table 3.16 Reconciliation of economic and financial flows

	consumer	dealer	FI	govt	GEF	total	global environ. benefit	total
Costs of SHS								
downpayment	-72	72				0		0
amount financed		288	-288			0		0
monthly repayments	-343		343			0		0
panel		-251				-251		-251
balance of system		-138		13		-126		-126
installation		-13				-13		-13
import duty on PV panel		-13		13		0		0
sales tax on SHS		-33		33		0		0
replacement& O&M costs	-110			11		-99		-99
						0		
avoided costs								
kerosene (incl.transport)	516			227		743		743
dry cells	23			-2		20		20
battery charging	69			-7		62		62
Incremental CS	168					168		168
GEF grant		91			-91	0		
environmental benefit							91	91
	251	4	55	287	-91	506	91	597
	24.0%					30.6%		40.9%

Figure 8: Winners and losers using change in consumer surplus as benefits (as NPV@10%, **constant 2003 US$): impact of single household with SHS**



Comparison with other countries

These results are generally consistent with results obtained in other countries, as shown in Table 3.17.

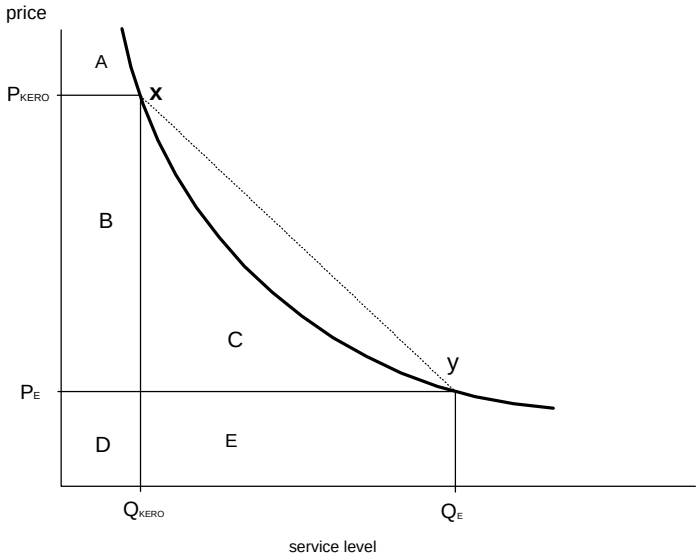
Table 3.17: Comparison with other countries (without any GEF subsidy): ERR

	Source	Replacement (avoided cost)	Consumer Surplus
Indonesia		24.1%	30.6%
Sri Lanka	ICR, Energy Services Delivery Project	8%	31%
Philippines	SAR, Rural Energy Project	15%	32-47% (20Wp-75Wp systems)
Bolivia	SAR, renewable energy project		27-40%

Attachment 1: Estimating the demand curve [11/]

Figure 9 depicts the demand for services (lighting, TV viewing) of a rural household. The demand curve is downward sloping, and typically has a shape that is concave (with respect to the origin). This shape frequently emerges where more than two points on the curve can be plotted (in Figure 2.1 only the points ***x*** and ***y*** are assumed known) [12]. A concave shape also follows from the (convenient) assumption of constant elasticity (an assumption often made in econometric models) [13].

Figure 9: Demand curve for electricity-provided services



Before electrification, these services are typically provided by a mix of kerosene (for lighting) and batteries (for TV and radio viewing). For simplicity, assume that the only service provided is lighting by use of kerosene lamps: the quantity of services so consumed is ***QKERO***, at the price ***PKERO***. The total household expenditure on lighting is therefore ***QKERO*** x ***PKERO***, equal to the area ***B + D***.

The total willingness to pay (WTP) for the service at level ***QKERO*** is the total area under the demand curve to that level of consumption, i.e. areas ***A + B + D.*** This is the total **benefit** to the consumer. However, the **cost** is area ***B + D,*** and therefore the net benefit, also called the consumer surplus, is the difference between the two, namely the area ***A***.

After electrification, the level of service (in the case of lighting, the number of lumen-hours) typically increases substantially; consumption increases from ***QKERO*** to ***QE***, but the price paid for the electrified service also falls (typically) from ***PKERO*** to ***PE***. Now the household's expenditure for electricity is ***PE*** x ***QE***, equal to the area ***D+E***.

At this level of consumption, the total area under the demand curve to ***QE***, i.e. the total benefit, is now the area ***A + B + C + D + E***. Therefore the net benefit, or consumer surplus, after subtracting the cost ***D + E,*** is ***A + B + C***. Thus it follows that the net economic benefit of electrification is the increase in consumer surplus, which is the area ***B + C***. [14]

Areas ***B, D*** and ***E*** are readily calculated from knowledge of consumption before and after electrification, from the household budget for kerosene (and battery charging), and from the tariff of electrified service: i.e. given knowledge of the two points on the demand curve ***x*** and ***y***, the areas ***B, D*** and ***E*** are immediately calculable. But area ***C*** is more difficult to estimate, since it requires knowledge of the *shape* of the demand curve between points ***x*** and ***y***. The most convenient assumption– and therefore the one most frequently encountered -- is that the demand curve is linear [15.]

Unfortunately such an assumption will lead to an overestimate of the area ***C***, and of the net benefits of electrification, because, as noted, the empirical evidence indicates that the demand curve is much more likely to have a concave shape, as shown in Figure 1: given some functional form for such a demand curve, the area C is readily calculated as the definite integral (see Box 1).

Box 1: Functional specification of the demand curve

For example, if the demand curve is specified as the simple exponential form of constant elasticity *b*

$$Q_2 = Q_1\left[\frac{P_2}{P_1}\right]^b$$

then given the two points in Figure 2.1 of x ($\boldsymbol{P_{KERO}, Q_{KERO}}$) and y ($\boldsymbol{P_E, Q_E}$), the elasticity computes to

$$b = \frac{\log \dfrac{Q_E}{Q_{KERO}}}{\log \dfrac{P_E}{P_{KERO}}}$$

The area C+E, the area under the demand curve between points x and y, then follows as the definite integral

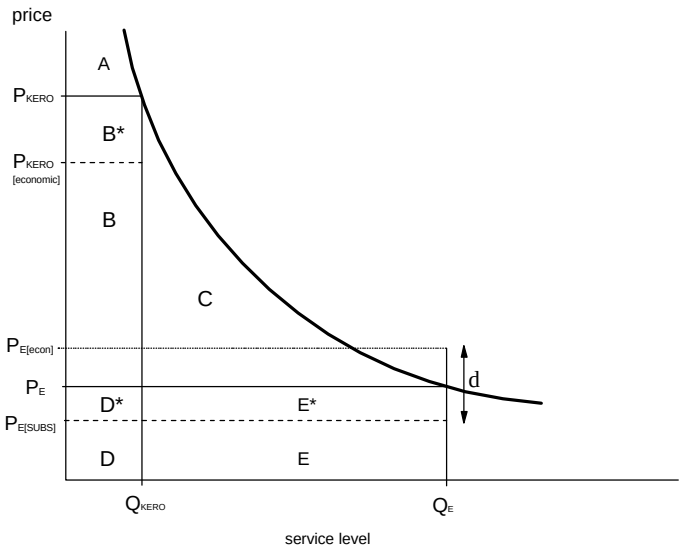
$$C + E = \frac{P_{KERO}}{Q_{KERO}^{1/b}} \int_{Q_{KERO}}^{Q_E} Q^{1/b}\, dQ = \frac{P_{KERO}}{Q_{KERO}^{1/b}} \Bigg|_{Q_{KERO}}^{Q_E} \frac{Q^{1+1/b}}{1+1/b}$$

In some studies (e.g. the World Bank's Solar Homes project in Bolivia) the area ***C*** is approximated as one third of the area determined by a linear demand curve

The consumer surplus calculations are done using financial costs (since these are the costs actually seen by the consumer). However, the financial and economic costs require careful enumeration, because often the quantities both before and after electrification are subject to taxes and subsidies. Figure 10 illustrates a typical situation where the price of kerosene is subsidized, and where electrification involves both taxes (e.g. VAT on construction costs) and subsidies (say provided by GEF).

Suppose the electrification subsidy per kWh, is ***d.*** Then one needs to distinguish between the economic and subsidized prices ***PE[econ]*** and ***PE[subs]*** respectively: the total amount of the subsidy is the area ***d QE***. Suppose that this subsidized price is also taxed at the rate t, the price to the consumer then increases to ***PE = PE[SUBS] + t*** (the amount of taxes collected being the area ***D*+E****). As drawn, the assumption is that the subsidy exceeds related taxes (which is the case for the micro-hydro systems, where the proposed subsidy far exceeds the amount of VAT and profits tax on construction). For kerosene, the total (financial) cost to the consumer is ***B*+B+D*+D***. Of this, the area ***B**** represents taxes.

Figure 10: Reconciliation of economic and financial flows.



The various economic and financial quantities therefore reconcile as shown in Table 20. For example, before electrification, the actual *economic* benefit is **A**+ **B*,** but the area ***B**** is captured by Government as tax, so what accrues to the consumer is only the area ***A***.

Table 3.18 Reconciliation of economic and financial flows.

	Kerosene	Electrification	Difference
Consumer surplus	***A***	***A+B*+B+C***	***B+B*+C***
Taxes and duties (VAT)	***B****	***D*+E****	***D*+E*-B****
Subsidy		***-dQ***E	***-dQ***E
Economic cost	***B+D*+D***	***D+E+dQ***E	***+E+dQ***E ***-B-D****
Total benefit to consumer (area under demand curve)	***A+B*+B+D*+D***	***A+B+B*+C+ D*+D+E*+E***	***C+E*+E***

Endnotes:

1/ It also follows that the NPV for a household that purchased a SHS for cash would also be zero

2/ Indonesia SHS Project Project Support Group, Final Report 2003

3/ P. Meier, *Economic Analysis of Solar Home Systems: A Case Study for the Philippines*, World Bank, 2003

4/ World Bank, Implementation Completion Report, Sri Lanka Energy Services Delivery Project, June 2003

5/ Draft SAR, Bolivia Renewable Energy Project, Annex 4: Economic Analysis, February 2003

6/ Vietnam System Efficiency Improvement, Equitization and Renewables Project (SEIERP):Economic and Financial Analysis of Community-based Small Hydro Projects, World Bank, December 2003

7/ To replicate the incremental cost analysis of the SAR it was necessary to use a non-standard methodology for the NPV calculation. Normally, all costs and benefits are assumed to occur at year end, and the NPV (as provided in standard spreadsheet functions) is calculated at the *beginning* of the first year. However, in the case of the GEF incremental cost analysis, the NPVs appear to have been calculated as coincident with the first payment (i.e. at the *end* of the first year). However, in the spreadsheet tables of the SAR, and IBRD-ICR, the normal conventions are used

8/ SAR, Annex 3.6, para 7-10

9/ The detailed survey report shows that households without SHS have also reduced their energy expenditure, which one would expect not just in response to the increase in Kerosene price, but also in response to the economic depression in Lampung in 2001-2002. The Lampung SHS survey report discusses the survey results in more detail.

10/ This table assumes an international price for kerosene of 38.5$/bbl, which is representative of the Singapore kerosene trading range over the past 9 months (in the range of $36 to 42$/bbl) with 0.5$/bbl added for freight differential

11/ This Annex is based on P. Meier, *Vietnam System Efficiency Improvement, Equitization and Renewables Project (SEIERP):Economic and Financial Analysis of Community-based Small Hydro Projects*, World Bank, December 2003.

12/ However, the demand curve is often taken as linear, which (for reasons explained below) tends to result in an overestimation of the benefits.

13/ A linear demand curve does *not* have a constant elasticity; in the case of Figure 7, for example, if the demand curve were a straight line between ***x*** and ***y***, the own-price elasticity at point ***x*** is different to the own-price elasticity at point ***y***.

14/ Therefore, for the calculation of net benefits of electrification, there is no need to calculate the area ***A.***

15/ For example, a linear demand curve was used in the Philippines study of rural electrification benefits (Barnes, D. F,. A. Domdom, V. Peskin, and H. Peskin. 2002. *Rural Electrification and Development in the Philippines: Measuring the Social and Economic Benefits*. ESMAP Report 255/02. Washington, D.C.: World Bank).

Annex 4. Bank Inputs

(a) Missions:

Stage of Project Cycle	No. of Persons and Specialty (e.g. 2 Economists, 1 FMS, etc.)		Performance Rating	
Month/Year	Count	Specialty	Implementation Progress	Development Objective
Identification/Preparation				
10/95	*4*	ECONOMIST (2), ENERGY SPECIALIST (2)		
Appraisal/Negotiation				
02/96	*4*	ECONOMIST (2); ENERGY SPECIALIST (2)		
05/96	*7*	ECONOMIST (2); ENERGY SPECIALIST (3); RESETTLEMENT SPECIALIST (1); ENVIRONMENTAL SPECIALIST (1)		
Supervision				
11/97	*3*	ECONOMIST (2); ENERGY SPECIALIST (1)	S	S
03/98	*3*	ECONOMIST (2); ENERGY SPECIALIST (1)	S	S
06/98	*3*	ECONOMIST (2); ENERGY SPECIALIST (1)	S	U
12/98	*3*	ECONOMIST (2); ENERGY SPECIALIST (1)	S	U
05/99	*3*	ECONOMIST (1); ENERGY SPECIALIST (2)	S	S
12/99	*2*	ECONOMIST (1); ENERGY SPECIALIST (1)	U	S
02/00	*2*	ENERGY SPECIALIST	U	S
09/00	*1*	ENERGY SPECIALIST	S	S
03/01	*4*	ENERGY SPECIALIST (1); ECONOMIST (1); FMS (1); LAWYER (1)	S	S
06/01	*3*	ENERGY SPECIALIST (2); ECONOMIST (1)	S	S
02/02	*4*	ENERGY SPECIALIST (2); PROCUREMENT SPECIALIST (2)	U	S
06/02	*4*	ENERGY SPECIALIST (1); PROCUREMENT SPECIALIST (1); FMS (1); FINANCE (1)	U	S
02/03	*1*	ENERGY SPECIALIST	S	U
06/03	*1*	ENERGY SPECIALIST	S	U
ICR				
02/04	*2*	OPERATIONS OFFICER (2)	S	U

(b) Staff:

Stage of Project Cycle	Actual/Latest Estimate	
	No. Staff weeks	US$ ('000)
Identification/Preparation	147.2	807
Appraisal/Negotiation	47.8	238
Supervision	113.7	650
ICR	10.3	52.8
Total	319.0	1,747.8**

Notes:
* Expenditures in FY1994-2000 marked up by 25% to convert direct costs to full costs, affecting 93% of total costs.
** Total cost include $838,930 (49%) from Bank Budget and $908,870 (52%) from GEF budget.
ICR totals as of June 17, 2004.

Annex 5. Ratings for Achievement of Objectives/Outputs of Components

(H=High, SU=Substantial, M=Modest, N=Negligible, NA=Not Applicable)

	Rating
☐ *Macro policies*	○ *H* ○ *SU* ○ *M* ○ *N* ● *NA*
☐ *Sector Policies*	○ *H* ○ *SU* ○ *M* ● *N* ○ *NA*
☐ *Physical*	○ *H* ○ *SU* ● *M* ○ *N* ○ *NA*
☐ *Financial*	○ *H* ○ *SU* ○ *M* ○ *N* ● *NA*
☐ *Institutional Development*	○ *H* ● *SU* ○ *M* ○ *N* ○ *NA*
☐ *Environmental*	○ *H* ○ *SU* ● *M* ○ *N* ○ *NA*
Social	
☐ *Poverty Reduction*	○ *H* ○ *SU* ○ *M* ● *N* ○ *NA*
☐ *Gender*	○ *H* ○ *SU* ○ *M* ○ *N* ● *NA*
☐ *Other (Please specify)*	○ *H* ○ *SU* ○ *M* ○ *N* ● *NA*
☐ *Private sector development*	○ *H* ● *SU* ○ *M* ○ *N* ○ *NA*
☐ *Public sector management*	○ *H* ○ *SU* ○ *M* ○ *N* ● *NA*
☐ *Other (Please specify)*	○ *H* ○ *SU* ○ *M* ○ *N* ● *NA*

Annex 6. Ratings of Bank and Borrower Performance

(HS=Highly Satisfactory, S=Satisfactory, U=Unsatisfactory, HU=Highly Unsatisfactory)

6.1 Bank performance	*Rating*			
☐ *Lending*	● *HS*	○ *S*	○ *U*	○ *HU*
☐ *Supervision*	● *HS*	○ *S*	○ *U*	○ *HU*
☐ *Overall*	● *HS*	○ *S*	○ *U*	○ *HU*

6.2 Borrower performance	*Rating*			
☐ *Preparation*	○ *HS*	● *S*	○ *U*	○ *HU*
☐ *Government implementation performance*	○ *HS*	● *S*	○ *U*	○ *HU*
☐ *Implementation agency performance*	○ *HS*	● *S*	○ *U*	○ *HU*
☐ *Overall*	○ *HS*	● *S*	○ *U*	○ *HU*

Annex 7. List of Supporting Documents

- Project Document, GEF, December 1996
- GEF Trust Fund Grant Agreement, March 11, 1997
- PSG Progress Reports
- Borrower Evaluation Report, prepared by BPPT, November 2003
- Implementation Completion Report, Solar Home Systems Project, July 2001 (Report No. 22588)
- "The Development Impact of SHS in the Province of Lampung", by Yayasan Dian Desa consultants, Final Report, September 2003
- Project Files

Additional Annex 8. Letter from BPPT responding to the request to provide comments on the ICR

FROM : FAX NO. : May. 31 2004 05:01PM P1

BPPT

AGENCY FOR THE ASSESSMENT AND APPLICATION OF TECHNOLOGY
(BPPT)
JL. M.H. THAMRIN NO. 8, JAKARTA 10340 - INDONESIA
TEL. : 316 2222 TELEX : 61331 BPPT IA FAX : 390 4537

SCANNED FILE
Action Zhou DATE 6/1/04 CC Meiss
FILE (Co/alpha/Pname or #) Ln/Cr GR/TF ESW Co/Rg Adm Proc
TF 28488

Jakarta, 31 May 2004.

Our ref : 126 /Dep.TIEML/BPPT/V/2004.

Mr. Yuling Zhou
Senior Operations Officer
Energy and Mining Sector Unit
East Asia and Pacifis Region
The World Bank Group

Subject : **Indonesia Solar Home Systems Project (GEF Grant TF28488 – Implementation Completion Report (ICR)**

Dear Mr. Zhou,

After reading the draft Implementation Completion Report (ICR), we as the government implementing agency and main recipient of technical assistance of the project, consider that the report is good. Therefore we would like to inform you that we do not have any comments on the Implementation Completion Report (ICR).

Sincerely yours,

Dr. Martin Djamin.
Deputy Chairman for Information, Energy,
Material and Environtmental Technologies, BPPT

Additional Annex 9. ICR Aide Memoire

Indonesia
SOLAR HOME SYSTEMS PROJECT (TF 28488)

February 2004 Implementation Completion Mission
Aide Memoire

A World Bank mission comprising Mr. Yuling Zhou (Sr. Operations Officer) and Ms. Esperanza Miranda (Operations Officer), visited Indonesia from February 2 through February 6, 2004 to review the implementation completion of the Solar Home Systems (SHS) project. This Aide Memoire summarizes the main findings of the mission and its discussions with Ministry of Finance (MOF), the Indonesian Agency for Application and Assessment of Technology (BPPT), the Directorate-General of Electricity and Energy Utilization (DGEEU); Bank Rakyat Indonesia (BRI), two participating companies, and Bank Niaga. A list of the people met during the mission is attached as Annex A. The mission expresses its appreciation for the support and generous hospitality received from the above institutions and participating companies. The mission would also like to express its thanks to P.T. Mambruk for organizing field visits to several SHS villagers in the province of Lampung.

The main objectives of the mission were the following: (i) to discuss the achievement of the project objectives and implementation experience with key stakeholders, with particular emphasis on lessons learned; (ii) to review the findings of Borrower's own project completion report and final report of the Development Impacts Study; and (iii) to review the operational arrangements for continued SHS operations and the prospects for project's sustainability.

Implementation Experience

All key stakeholders agreed that the project has provided substantial support for the commercialization and market development of SHS, but its implementation was adversely affected by the financial crisis of 1997 -which hit the country as project implementation started – and by the resulting weak business environment. As a result, the number of SHS units sold under the project was well below expectations. By the end of the project, a total of 8,054 units had been installed compared to the appraisal target of 200,000 units, and below even the January 2001 revised targets of 70,000 units.

Despite the low levels of SHS units throughout implementation, the project achieved substantial results in the areas of institutional development, mainly through the development of strict technical criteria and procedures for testing and certification of SHS units by LSDE-BPPT, which enabled LSDE-BPPT to obtain ISO 17025 accreditation for PV components testing, an achievement that went beyond original target. In addition, the Project Support Group (PSG), established under the project, effectively carried out field audits and other monitoring responsibilities and provided capacity building and technical assistance to participating bank and dealers (particularly on market and business development matters).

A long standing constraint in Indonesia and a factor affecting project implementation has been the practice of local governments procuring SHS units which are then provided to households on a free or highly subsidized basis. This practice has worked against commercial market development, and it's a key concern for participating companies. According to one of the participating SHS dealers, the project was helpful in changing perceptions among SHS users who were dissatisfied with the lack of service provided by the procurement approach of these government funded programs.

According to Bank Niaga, a constraint for commercial banks for entering the SHS market development business is their limited access to rural areas, and cost-effectiveness in ensuring timely loan repayment in rural areas.

Project Sustainability

There was a general consensus among the officials and companies met during the mission that market conditions are improving and demand for SHS is picking up. Public awareness of the benefits of SHS is also increasing. One of the participating companies informed the mission that due to improving market conditions, the Association of Indonesia SHS Dealers has been reactivated after several years of inactivity, to further promote SHS market development and provide assistance to member companies.

Prospects for project sustainability are good. BPPT continues to implement SHS programs in support of the Government's goal to increase renewable energy utilization to meet energy demands in an efficiently, reliable, end environmentally sustainable way. BPPT informed the mission that some of these programs are based on financing sharing arrangements between BPPT and local governments, with rural households paying for the down payment to purchase a SHS unit. Service and equipment maintenance is provided by local government units, which in turn, receive training and technical support from BPPT. While these programs still involve official subsidies, they represent a positive step towards the direction of a more market based approach.

The proposed BRI-SDF guarantee facility for SHS credits – expected to be effective in March 2004 – is a significant step towards further SHS market development as it will provide access to consumer finance to SHS customers, a main barrier to PV market development in Indonesia. The facility would be established by deposits made by the dealers funded by loans from SDF to the dealers. The SDF would guarantee up to 30% of the loans while the remaining 70% would be guaranteed by the dealers. The maximum loan amount that can be provided by BRI to the SHS consumers is RP 3 million (about $350 equivalent) per unit, with a maximum loan maturity period of 24 months at interest rates set by BRI. The facility will be initiated on a pilot basis for a targeted 1,500 customers located in the areas of South Sumatera, Riau, and South Sulawesi provinces.

SHS Dealers Commercial Operations

The two participating dealers met during the mission show total readiness to move to full commercial operations. Both companies have been aggressively developing their rural distribution networks over the past year as well as aggressive marketing campaigns (one dealer is doing door-to-door advertisement, and the other is offering an increasing selection of SHS products). Further, business and technical capabilities of SHS dealers have improved substantially through years of business experience and through direct support from the project. As a result, dealers are more confident now on their capacity to work together with financing institutions and government agencies on establishing credit facilities to increase consumer affordability and a national strategy plan for SHS market development, respectively.

Pilot Development Impacts Study

The mission reviewed the final follow up survey and analysis for the pilot development impacts study conducted in Lampung of 50 households with and 50 households without SHS during a one-year period. The study found positive impacts of SHS, ranging from additional lighting for more hours of study by children, reductions in expenditures for kerosene, increased use of the SHS house for social gatherings to

better appreciation of the house. On the other hand, the use of SHS has not directly improved the household income except for a few households whose shop services could be extended until late at night.

The mission visited several households with SHS in the Lampung area to confirm the findings of the development impacts study. The mission found that with the exception of one household, end-users were satisfied with their SHS units which were used for lighting and small electronic appliances, such as TVs and radios. End-users were familiar on how the equipment functions, and some of them were able to take care of small repairs and general equipment maintenance. A household was dissatisfied with the SHS system installed in their house because malfunctioning of the SHS unit. The mission advised the household members that this problem could be solved by seeking assistance from the dealer about re-charging the battery or replacing it at not cost if equipment and installation is still under the warranty period.

Next Steps

A draft ICR will be prepared by the ICR mission team by April 2004, and will be submitted to the Borrowers for comments by mid-May 2004. The final ICR will be distributed to the Bank's Board of Directors by June 30, 2004.

Annex A
List of People Met

Ms. Ratna Ariati	Director for New Renewable Energy and Energy Conservation, Ministry of Energy and Mineral Resources
Mr. Kosasih Abbas	Head of New Renewable Energy Division, Ministry of Energy and Mineral Resources
Dr. Martin Djamin	Deputy Chairman for Information, Energy, Material and Environmental Technologies, BPPT
Dr. Agus Rusyana Hoetman	Head of Energy Technology Laboratory, UPT-LSDE BPPT PUSPIPTEK
Dr. Arya Rezavidi	Staff of Energy Technology Laboratory, UPT-LSDE BPPT PUSPIPTEK
Ir. Febrian Alyuswar	Renewable and Energy Conservation Division Staff, BPPT
Ms. Ir. Ira Fitiriana S. Si	Renewable and Energy Conservation Division Staff, BPPT
Ms. Poppy Irmasari	Sub Manager, Business Development Group, Bank Niaga
Muhamad Rifai	Head of Business Micro Division, Bank Rakyat Indonesia
Mr. Bambang Widjanarko	Micro Business Division, Bank Rakyat Indonesia
Mr. Feri Sudiarto	Micro Business Division, Bank Rakyat Indonesia
Mr. Agus	Micro Business Division, Bank Rakyat Indonesia
Mr R.M. Sudjono Respati	Director, PT. Mambruk Energy International
Mr. Himsa Simanjuntak	Head of Lampung branch, PT. Mambruk Energy International
Ms. Yanidar Witjaksono	Director, PT. Sundaya Indonesia
Mr. Hermani Noor	Head of Sub Directorate of Foreign Loan and Grant I, Directorate of Foreign Fund - Directorate General of Budget, Ministry of Finance
Ms. Sedardjuningsih	Staff of Sub Directorate of Foreign Loan and Grant I, Financial, Mining and Energy Directorate of Foreign Fund - Directorate General of Budget, Ministry of Finance