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THE WORLD BANK GROUP

Micro Hydro Power (MHP) Return of Investment and Cost Effectiveness Analysis

Final Report

17 September 2012

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Prepared for: The World Bank Group

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The authors of this study are as follows:

- Architrandi Priambodo: lead the management of the study as well as the main contact for communication with the PSF Facility/World Bank
- Stuart King: lead the financial and socio-economic analyses
- Syaiful Ibrahim: provide support for site visit and advise regarding MHP operational issues

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EXECUTIVE SUMMARY

This report presents the study on return and investment and cost effectiveness of the micro hydro (MHP) developments under *Program Nasional Pemberdayaan Masyarakat Lingkungan Mandiri Perdesaan* (PNPM- LMP) (herein after is referred to as PNPM Green), a pilot under PNPM *Perdesaan* (Rural)), a Government of Indonesia (GoI) program of the Go, aims at assisting villagers located in rural locations to benefit from improved socio-economic and local governance conditions, and conducted as Technical Assistance to Government of Indonesia (GoI).

The scope of the study covers the MHP developed under earmarked block grant for MHP with the assistance of MHP Technical Support Unit (TSU), and the MHP developed under Natural Resources Management (NRM) block grant without TSU support. There are 155 MHP sites developed under PNPM Green with the size ranging from 2 kW to 78 kW and 40 of them have been commissioned and handed over to the community. The study is focused on the return on investment and cost effectiveness of MHP that have been put into operation. 15 sites are selected as the sample study covering 10 TSU-supported sites and 5 non-TSU supported sites, of which 11 are located in Sulawesi and 4 sites are in Sumatera. When the site visit was conducted, these sites have been handed over to the community for about 2 years to 2 months.

Key Findings

- The average capital cost per MHP installation in the survey sample is Rp.IDR 545.1 million (or approximately $54,500) whilst average cost per kW is RpIDR. 33.6 million (or approximately $3,500/kW). By comparing these data with analysis of other similar studies, a very favorable overall assessment may be made of the PNPM program from a pure capital cost point of view, considering that the average of capital cost/kW of MHP PNPM Green is still comparable with the range of capital cost per installed capacity of MHP developed in other schemes (US$ 2000/kW to US$ 10,000/kW for installed capacity between 5 kW to 30 kW). Capital cost/kW of TSU sites is slightly higher than Capital Cost of Non-TSU sites

- Smaller number of Household connected compared to the planned number of household connected are found in sites where alternative energy service, notably electricity from PLN grid, is available

- The average in-kind contribution proportion of TSU supported sites, based on 10 TSU sites visited, is about 2% of the total capital cost whilst that of non-TSU supported sites is about 9%.

- Most of the MHP sites of PNPM Green deploy operation and management team that consists of the manager (head of the team), secretary, finance/accounting (*bendahara*), and operator(s).All the communities surveyed are collecting more revenue than they are disbursing in operational costs). On average the operating profit registered by the communities is 35%.

- It is observed that villages that have already established proper tariff and management team (UPT) are mostly aware of the importance of keeping revenue and expenses records but have low awareness in keeping technical records

- A positive assessment may be made of the operational status of the MHPs surveyed, in terms of number of household connected, electricity consumption pattern, planned vs actual electricity connection and installed capacity and power output delivery. The majority of schemes appears to be working well and, as discussed further below, is providing a valuable service to the communities. Some communities do appear to be experiencing some operational difficulties and there is a concern about the number of planned connections that fail to materialize. Important operational issues found during the survey is mis-match of design and actual water flow capacity resulting in under delivery of power output, lack of monitoring and recording of technical performance such as kWh generated and regulaer maintenance of MHP installation and construction (e.g power house, weir, access to weir and forebay, etc).

- Simple cashflow analysis suggests that without taking into account the fuel saving cost into the calculation and not considering major repair, most of the MHP schemes under PNPM Green, both TSU and non-TSU shows a negative NPV. Only when fuel cost saving is factored in the calculation, 13 out of 14 sites shows positive result. This indicates these MHPs are not viable in generating financial return. In general – micro hydro schemes in rural communities are not expected to be profitable investments. That is why the government needs to step in and provide grant funding in the first place.

- Many community households are able to enjoy significant fuel cost savings thanks to the electrification of their village. Moreover, electric power has also resulted in enhanced economic benefits through, for example, shops being able to stay open for longer and new business ventures being set up (e.g. baking, games rental). The expectation is that this economic productivity will only increase over time with the result that the income of the community will be significantly enhanced. It should be noted that there are also some (very limited) economic costs associated with the scheme. For example, there is a negative income impact upon those households that previously sold kerosene and other fuel. However these costs are significantly outweighed by the benefits incurred by (usually) the same households.

- The PNPM program has also brought significant intangible benefits to the villages. For example, the better quality of light enjoyed by connected households enables children to study for longer periods and also enhances the social interaction of the community.

ABBREVIATION/GLOSSARY

BLM	Bantuan Langsung Masyarakat
CDD	Community-Driven Development
CSO	Civil Society Organization
GIZ	Deutsche Gesellschaft fur Internationale Zusammenarbeit
GoI	Government of Indonesia
MDST	Musyawarah Desa Serah Terima
MHP	Micro Hydro Power
MoHA	Ministry of Home Affairs
NMC	National Management Consultant
PMD	Pemberdayaan Masyarakat Desa
PNPM	Program Nasional Pemberdayaan Masyarakat
PSF	PNPM Support Facility
TP3	Tim Pelaksana Pemelihara Prasarana
TPK	Tim Pelaksana Kegiatan
TSU	Technical Support Unit
UPK	Unit Pelaksana Kegiatan
UPT	Unit Pelaksana Teknis

1. INTRODUCTION

1.1 BACKGROUND

National Community Empowerment in Rural Areas project or Program Nasional Pemberdayaan Masyarakat (PNPM-Ruralaims at assisting villagers located in rural locations to benefit from improved socio-economic and local governance conditions. The program is conducted as Technical Assistance to Government of Indonesia (GoI) and the executing agency for PNPM Rural is the Village and Community Empowerment Directorate (*Pemberdayaan Masyarakat dan Desa*, PMD) within the Ministry of Home Affairs (MoHA).

PNPM Green is a pilot program under PNPM-Rural Program that is designed to further integrate environmental issues into the local community-driven development (CDD) planning process. PNPM Green is only active in selected target locations in Sulawesi and Sumatra Islands and the block grant funding is earmarked to support community investments in 'green' sub-projects. About 50% of the block grant funding disbursed through PNPM Green is allocated specifically to finance micro-hydro power (MHP) in selected target locations. The particular focus of PNPM Green on decentralized MHP is based on the environmental and social features of MHP. Specifically: (i) it is in demand by rural communities deprived of electricity and located far from the electricity network; and (ii) MHP is dependent on a continued and protected water flow which is best ensured through communities' effective management of surrounding water catchment areas. Development of the PNPM Green projects is facilitated by National Management Consultant.

Under PNPM Green, there are two types of MHP development: (i) MHPs developed through support of block grant (BLM or *Bantuan Langsung Masyarakat*) dedicated for MHP development (the 50% allocated block grant for MHPs). This MHP development is technically supported by TSU; (ii) MHPs developed through support of block grant under Natural Resources Management (NRM) Block Grant. NRM block grant supports variety of activities proposed by the village community, and MHP development is one of them. The MHP development funded by NRM block Grant is not technically supported by TSU.

To date, using block grants disbursed during 2008, 2009, 2010 and 2011 participating communities have selected 155 MHP schemes in Aceh, North Sumatra, West Sumatra, Bengkulu, North Sulawesi, South Sulawesi and West Sulawesi. Once these schemes are completed they are projected to generate approximately 1,250 kW of electricity, servicing approximately 40,000 individuals. The individual MHP schemes range in size from 2 kW to 78 kW (average scheme size: 15 kW), and have an average block grant budget of $80,000.

The micro-hydro power Technical Support Unit (TSU), managed by GIZ, has been established as a complement to PNPM green to mitigate the lack of specific but indispensable MHP know-how within PNPM and to gradually enhance local skills and broaden the local MHP sector. This initiative – funded through a joint partnership of the Government of the Netherlands and Germany – is targeted at providing technical assistance in the preparation, implementation and subsequent operation and management of MHP. Figure 1.1 illustrates the roles played by TSU and NMC in development of MHP under Green PNPM.

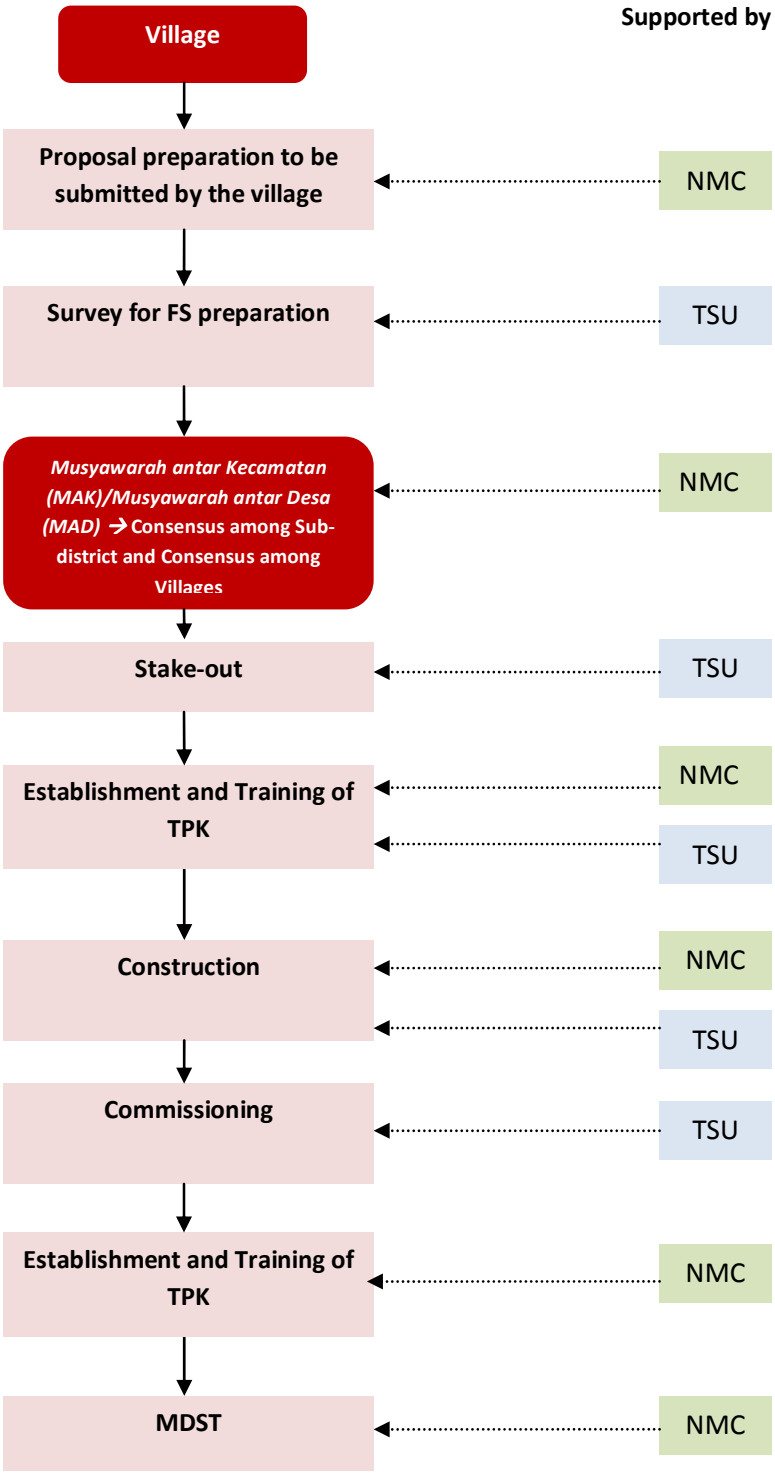


Figure 1.1 Role of TSU and NMC in the development of MHP under PNPM Green

1.2 RATIONALE

In view of the impressive progress of MHP development under PNPM-Green, it is important to evaluate the economic impact of PNPM Green's MHP interventions to see how effective PNPM Green has been in expanding quality energy services to rural communities – and at what cost. In particular, there is a need to evaluate the return on investment (ROI) and cost effectiveness of PNPM Green's interventions. Such an evaluation would compare the costs associated with PNPM Green MHP schemes, and

energy service quality with other approaches to rural electrification within the target locations.

1.3 OBJECTIVES AND SCOPE

The objective of this assignment is to identify the effectiveness of PNPM green in the provision of quality energy services to rural communities through an evaluation of the economic impact of PNPM Green's MHP. This is done by assessing quantitative/qualitative data related to PNPM green, conducting comparative analysis on PNPM green with TSU and without TSU assistance (The NRM block grant), identification of other rural electrification approach in the PNPM Green sites and presenting the evaluation and analysis results to GOI, World Bank, and Development Partners (donors).

The original TOR of the study suggested comparison with MHP developed under PNPM Rural. However, the final study focuses only MHPs developed under PNPM Green, both with and without assistance of TSU (NRM block grant) because (i) the main targeted beneficiaries of MHP PNPM rural are the same as those of MHP PNPM Green; (ii) the PNPM Gree - NRM block grant and PNPM rural block grant are both not earmarked for specific activities; (iii) the mechanism of block grant approval for PNPM Rural and Green PNPM are assumed to be similar; and (iv) technical facilitation supports received by both PNPM Rural and PNPM Green-NRM block grants are from the same group of people (i.e. the same level of supports). Therefore, it is fair to say that the quality of MHP schemes under PNPM Rural may technically be considered to be the same as the ones developed under the PNPM Green - NRM block grants.

1.4 APPROACH/METHODOLOGY

The methodology of the study is illustrated in Exhibit 1.1. The study activities comprise of project mobilization and data gathering, analysis on financial and economic impact, analysis on operation and management quality of MHP with TSU assistance and of MHP with NRM block grant. 15 (fifteen) sites are selected to represent the MHP developed under PNPM Green and is summarized in Exhibit 1.2 while Exhibit 1.3 shows the location of field visits at district level. Detailed methodology is given in Appendix E.

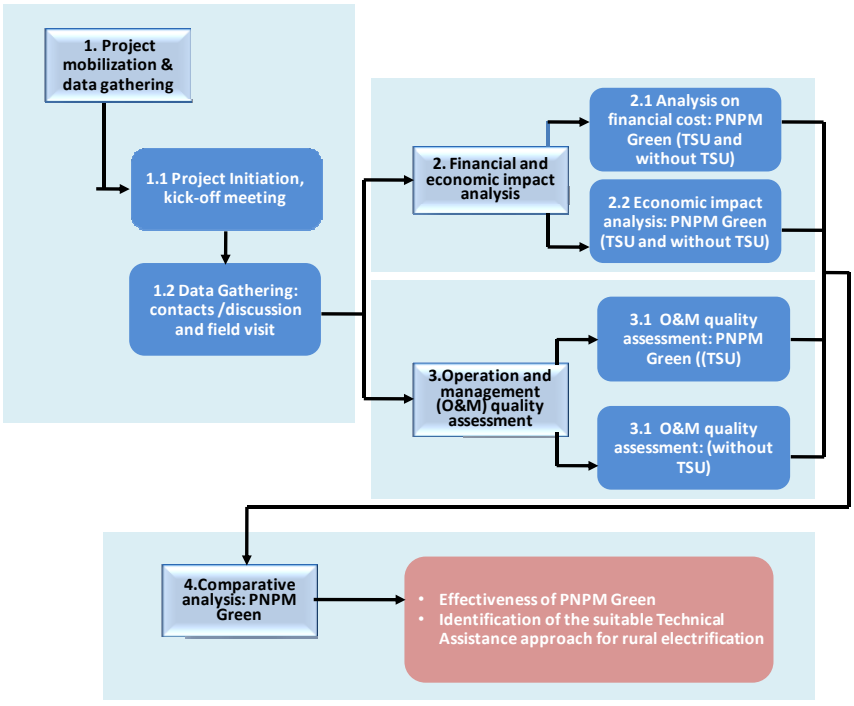
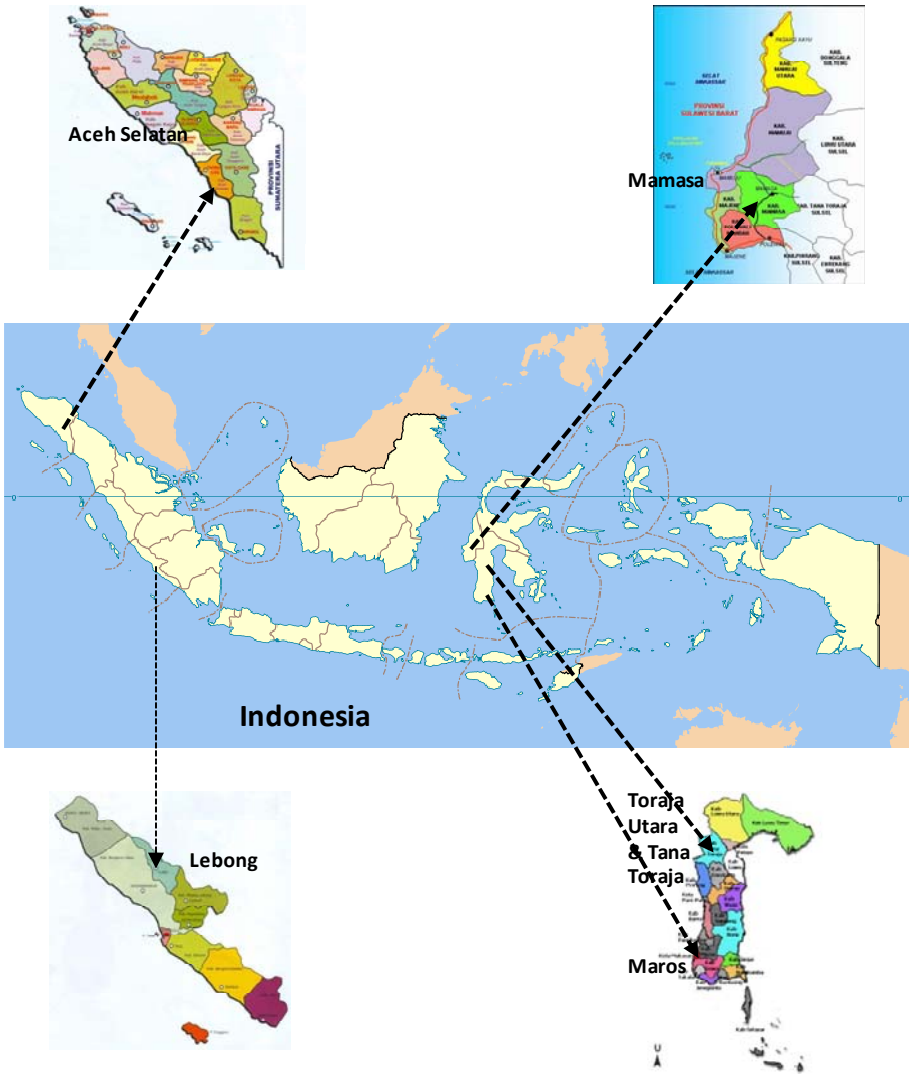


Exhibit 1.1 Return on Investment and Cost Effectiveness Analysis, MHP of PNPM Green

Exhibit 1.2 Selected Sites for Field Visit

Province	District	Site location	MDST Date	installed capacity and number of Household connected	Non-TSU	TSU
West Sulawesi	Mamasa	Kec Mehalaan/Mesakada	December 2010	78 kW, 305 households		1
		Kec Sesena Padang/Orabuan Selatan	November 2011	in operation, 14 kW, 99 households		2
		Kec Bambang/Masoso	January 2012	in operation, 22 kW, 70 Households		3
		Kec. Aralle/ Salutambun Barat	October 2011	in operation, 20 kW, 40 households		4
South Sulawesi	Toraja Utara	Kec Rantebua/Bokin	March 2012	in operation, 6 kW, 46 Households		5
		Kec. Rantebua/Buangin	March 2012	10 kW, 63 Households		6
		Kec Nanggala/Kare Pennanian	June 2012	12 kW, 20 Households		7
	Tana Toraja	Kec saluputti/Saluburonan	November 2010	30 kW, 77 Household	1	
		Ke. Malimbang Balepe/Leppan	December 2010	30 kW, 168 Household	2	
	Maros	Kec. Camba/ Timpuseng	April 2010	20 kW, 66 Household	3	
		Kec. Mallawa/Barugae	March 2011	20 kW, 77 Household	4	
Aceh	Aceh Selatan	Kec. Kluet Tengah/Alur Kejrun	June 2012	6.7 kW, 50 Household		8
West Sumatera	Padang Pariaman	Kec IV. Koto Aur Malintang/Batu Basa	June 2012	10 kW, 10 Household		9
	Pasaman	Kec. Mapat Tunggul/Mapunapan/Marapan	May 2012	11 kW, 70 Household		10
Bengkulu	Lebong	Kec Padang Bano/Benteng Besi	July 2012	Operation only 6 months after MDST, it is currently run by Diesel. 5 kW, 30 Household	5	

Exhibit 1.3 Site Location at District Level (*Kecamatan*)


Aceh Selatan
Mamasa
Indonesia
Lebong
Toraja Utara & Tana Toraja
Maros

2. FINANCIAL AND OPERATIONAL ASSESSMENT

This Chapter presents the results of the financial analysis and assessment on the operational conditions of the MHP PNPM Green. It discusses some issues on capital expenditures, compares the capital cost per installed capacity with those that have been implemented with other studies and discusses the operational issues and challenge in operating the MHP of PNPM Green, both with and without TSU assistance.

The analysis is based on the survey on 15 sites as detailed in Exhibit 1.2. During the site visit, it was found out that the MHP sites in Benteng Besi Village only operates for six month during rainy season. The village was electrified with Diesel generator instead of MHP when the site visit was conducted. Thus, data on electrification service of Benteng Besi village was not considered in most of the quantitative analysis regarding cost and financial analysis. There are 14 sites covered in calculation for quantitative analysis presented in this Chapter.

2.1 CAPITAL EXPENDITURE

This section presents the analysis of the capital expenditure (capex) profile of the different micro hydro projects (MHP) that were surveyed. It discusses the overall assessment of the capex undertaken and some particular capex issues.

2.1.1 Total Capital Expenditure

Exhibit 2.1 provides a summary of the average capital cost/kW of MHP installation from 14 schemes. This capital cost calculated takes into account block grant size for technical portion[1] , equity contribution, if any, and in-kind contribution of the community, for each sample size. The average capital cost per MHP installation in the survey sample is IDR 545.1 million (or approximately $54,500) whilst average cost per kW is IDR. 33.6 million (or approximately $3,500/kW). However, as can be seen from Exhibit 2.1, average cost per kW varies significantly according to the size of the scheme.

Exhibit 2.1 : Average Capital Cost/kW of MHP Installation

Scheme Size (kW)	Average Cost (IDR/kW)	Average Cost ($/kW)
≤10	61,785,812	6,514
>10 but <20	34,286,578	3,615
≥ 20	17,269,916	1,821
Overall (14 schemes)	33,635,171	3,546

Note: Exchange rate $1 = IDR. 9,485

Benchmarking/comparative analysis with results of similar studies: Exhibit 2.2 presents a summary of capital cost/kW of Micro-Hydro Schemes under other similar studies/programs. The criteria for comparison with MHP of PNPM green are: (i) the size

[1] The block grant comprises fund allocated for civil construction, M&E procurement and installation and protection for catchment area. To facilitate comparative analysis of capital cost on MHP development with other studies, the capital cost calculated only takes into account the fund allocated for civil and M&E portion.

of the MHP implemented is in the range of 5 to 100 kW; (ii) the objective of the scheme is to provide electricity for rural communities (iii) the scheme covers only off-grid MHP rural electrification. The observations are made as follows:

- In a study comparing the investment costs of micro hydro systems constructed in Rwanda (Entec & GVEP International, 2011) a 5 kW system would be expected to cost around US$ 10,000 per kW, whereas a 25 kW system would be budgeted at US$ 4,000 per kW.
- The investment cost of six sites in Rwanda with a capacity of less than 5 kW sites ranged from US$ 2,941/kW to US$ 12,000/kW with the average being US$ 7,133/kW. Similarly sized sites in Indonesia could be expected to be in the range of US$ 7,500/kW to US$ 15,000/kW with an average of around US$ 10,000/kW.
- The investment costs of two sites with a capacity of approximately 20 kW were US$ 552/kW and US$ 2,043/kW. In Indonesia the average investment cost of a 20 kW plant could be expected to be around US$ 4,000/kW.
- An Indian benchmarking study undertaken by the World Bank's South Asia Sustainable Development Energy Unit (Mukherjee and Banerjee, 2012) indicated that for micro hydro schemes up to 10kW in capacity, the average capital cost per kW is $4,800.
- A Scaling-Up Renewable Energy Program (SREP) (SREP, 2012) in Rwanda that constructed seven micro hydro schemes did so at an average cost of $3,728/kW.
- An electricity access study undertaken in Rwanda (Castalia Strategic Advisors, 2009) indicates that the average cost of micro-hydro generator and mini-grid distribution infrastructure is $3,000/kW. The same study estimated that the cost per household (HH) of providing electricity access started at $1,300/Household in the initial years of electrification and reduced to $880/Household as the scale of the program increased.

By comparing these data of other studies/schemes with the calculated capital cost/kW of the MHP survey sample of PNPM Green, a very favorable overall assessment may be made of the PNPM program from a pure capital cost point of view, considering that capital cost/kW (US$ 1,821/kW to US$ 6,514/kW for installed capacity between 6 kW to 78 kW), is still comparable with the range of capital cost per installed capacity of MHP developed in other schemes, and even lower.

Nevertheless, such comparisons need to be treated with caution as much depends, of course, on the nature of the materials used (e.g. PVC versus steel penstocks) as well as assumptions used in making the calculations (e.g. the six Rwanda sites noted in the Entec study did not include substantial in-kind assistance provided by the communities in the capital cost estimation) as well as other local factors such as labour costs. A more accurate comparison is perhaps made with the Indonesia benchmark costs also indicated in the Entec study.

Exhibit 2.2 Comparison of MHP Capital Cost/kW based on similar scheme

Location/Country	MHP size (kW)	Year	Average Capital Cost (US$/kW)	Source of Financing of MHP Development
Indonesia	≤10	2012	6,514	MHP PNPM Green
	>10 but <20		3,615	
	≥ 20		1,821	
Rwanda	5	2011	7,133	District authority/local entrepreneur
	25		2,043	
Indonesia	5	2011	10,000	Government grant projects
	25		4,000	

Location/Country	MHP size (kW)	Year	Average Capital Cost (US$/kW)	Source of Financing of MHP Development
Rwanda	n.a	2009	3,000	Government budget (in plan)
Peru	33	2005	3,400	Grant through NGO (*Practical Action*)
Srilanka	25	1994	2,181	Grant through NGO (*ITDG*)
	10	1998	2,203	Grant (British Embassy/*ITDG*)

2.1.2 TSU vs Non-TSU Capital Expenditure

A comparison was made of the capital costs of the four Non-TSU schemes that were sampled with the three similar sized TSU schemes. As the data indicated in Exhibit 2.3 indicates, only a slight difference between the approaches (around 23% difference) although the small sample size should be taken into account. The approximate difference between TSU and non-TSU for micro hydro of about 20 to 30 kW is about US$ 300/kW. The additional cost/kW of TSU is contributed to better material quality and additional training and capacity building through TSU support, which may likely lead to better sustainability of the MHP operation.

Exhibit 2.3 : Average Capital Cost / kW of TSU vs. Non-TSU Schemes

TSU/Non-TSU	Number of Schemes	Scheme Size (kW)	Average Cost (Rp.) / kW	Average Cost ($) / kW
TSU	3	15 – 30	18,783,867	1,980
Non-TSU	4	20 – 30	15,211,213	1,604

Note: Exchange rate $1 = IDR. 9,485

2.1.3 Capex per installed capacity (IDR/kW) vs Capex per Number of Household Connected (IDR/HH)

One would expect these two metric (Capital cost/kW and Capital cost/ number of HH connected) to be closely linked i.e. the more customers the larger the size of the scheme. In fact this is not always the case. More specifically, the four highest capital cost/kW communities in the survey by quite some way are Alur Kejrun, Batu Basa, Bokin, and Kare Penanian. Each cost between IDR 50 – 90 million/kW. Most of the rest of the sample cost below IDR 30 million / kW. Two of these four communities (Batu Basa and Kare Penian) also have significantly higher capital costs/household than the other villages in the sample at over Rp. 50 million / kW. The remainders are clustered in the IDR 10 million / kW or less mark. This may be explained by the smaller number of connected households than forecast for Batu Basa and Kare Pennanian. Interestingly, both sites have alternatives to MHP for their electricity services: PLN grid has entered Batu Basa and there is another MHP scheme run by a Non-Governmental organization in Kare Penanian. These are valid reasons of low number of connection to MHP due to other electricity services available.

The equity contribution (both case and in-kind) made by communities averaged less than 0.5% of the total cost of the scheme. In Barugae, the in-kind contribution from the community is quite significantly higher than other sites (about 27%). In three sites:

Mesakada, Timpuseng and Leppan, equity contributions (cash contributions) of between 5 – 10% of total cost were also made.

The average in-kind contribution proportion of TSU supported sites, based on 10 TSU sites visited, is about 2% of the total capital cost with the highest contribution of about 6% and there is also one site where there is no in-kind contribution from the community. The average in-kind contribution proportion of Non-TSU supported sites is about 9% from the survey sample (4 sites). Barugae, highlighted above with 27% in-kind contribution proportion to total capital cost, is a non-TSU supported site. Further observation may need to be made to confirm this hypothesis due to small sample size of Non-TSU site.

Exhibit 2.3 Capital cost/kW vs Capital Cost/Number of Household Connected

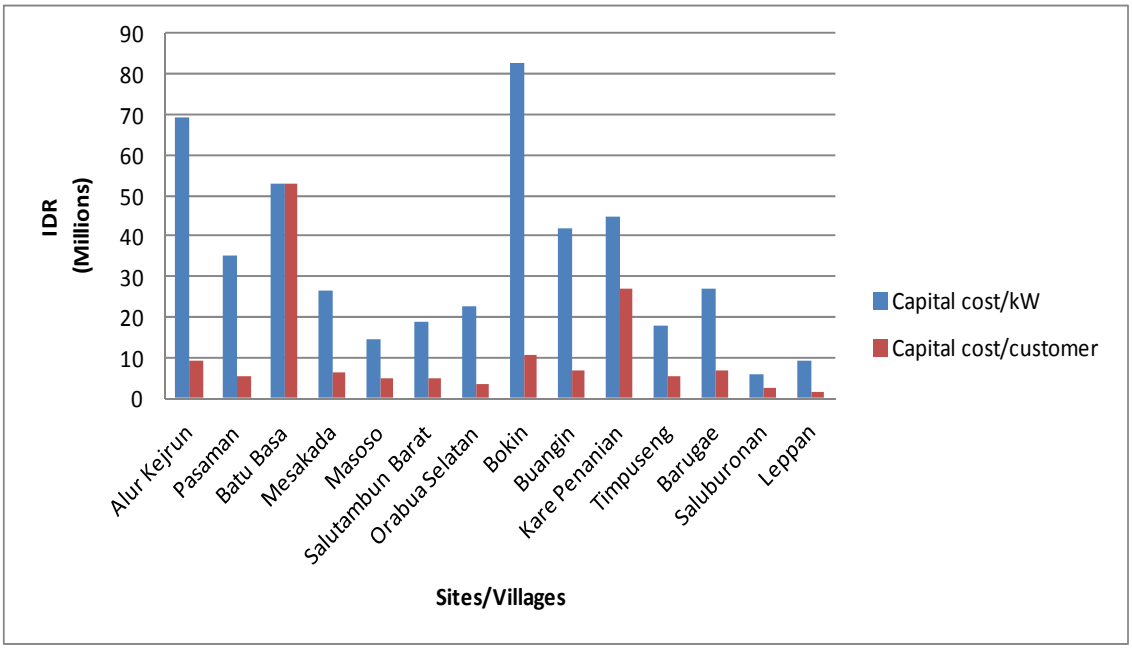


Exhibit 2.4 a Share of Community Contribution to Total Cost

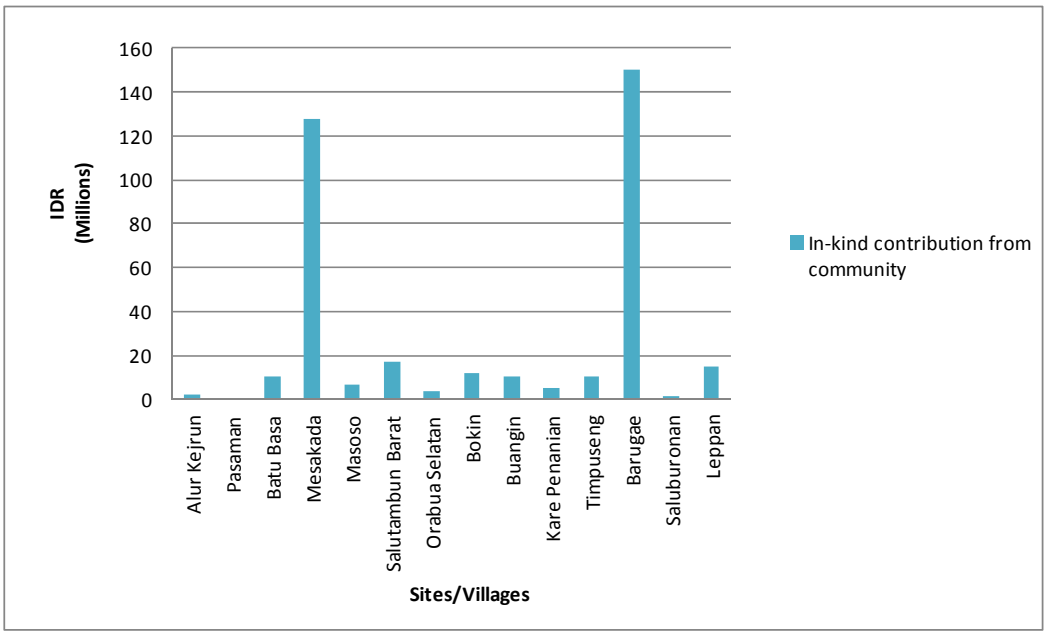


Exhibit 2.4 b. TSU and non-TSU In-kind Contribution to Total Capital Cost

In-kind Contribution Proportion to Total Capital Cost		
TSU	Average	1.98%
	Max	6.16%
	Min	0
Non-TSU	Average	9.06%
	Max	27.52%
	Min	0.64%

2.2 OPERATIONAL ASSESSMENT

2.2.1 Institutional set-up/management

Structure: Most of the MHP sites of PNPM Green deploy operation and management team that consists of the manager (head of the team), secretary, finance/accounting (*bendahara*), and operator(s). The manager oversees the overall management and operation of the MHP , both financial and technical; the secretary records the operational information such as number of consumers, any changes in tariff and minutes of meetings of the operational and management team (if any); the finance personnel collects and records payment and operational disbursement, and keeps track of the reserve fund (revenue received from payment subtracted by operational cost); and the operator(s) is in-charge of operating the turbine and maintain the condition and performance of the MHP.

10 out of 15 villages visited manages the MHP operation with 5 (five) personnel of which 2 (two) are operators and the remaining three personnel are the manager, secretary and

finance personnel. Additional personnel is identified in few of the sites visited (Barugae and Salutambun Barat) who provide supports in collecting payment from consumer. In Salutambun Barat, the village consists of 7 sub-villages that connected to the MHP and each sub-village has one representative in the management team who is responsible for collecting electricity payment from his sub-village.

In Alur Kejrun and in Buangin, only one personnel is currently responsible for the MHP operation, acting as manager as well as the operator. In Buangin (it has just reached MDST status in March 2012), consumer has not yet been imposed for payment since the generator had just started a stable operation for few weeks when the field visit was conducted due to major generator failure a couple of months after MDST. Proper tariff structure, operation and management structure and the remuneration structure for the operation and management team has not yet been established. In Alur Kejrun (MDST in June 2012), regular payment was just established for a month when the field visit was conducted. The management structure has been established and officially authorized by the head of the village through the village regulation (*peraturan desa*) but has not yet implemented in operation. It is observed that the management structure as seen in other villages is required to ensure a timely payment collection and recording/book keeping.

Operational cost, remuneration structure and reserve fund: Exhibit 2.5 presents some summary operational cost data for thirteen of the fourteen the survey sites.One of the village visited, Buangin, has just started stable operation for a month and proper tariff structure was not yet in place during the survey. Thus, this site is not included in the cost analysis.

Exhibit 2.5 Summary of Operational Cost

No.	Operational Cost Components	Share of Operational Cost to Total Revenue (%)		
		Average	Max	Min
1	*Operational cost / total revenue*	65%	79%	44%
2	*Operational cost breakdown*			
	Staff (average)	79%		
	O&M (average)	20%		
3	Number of staff	5	12	1
	Staff Operational Cost Breakdown	Share of Staff Cost to Operational Cost		
		Average	Max	Min
	Head of UPT (Manager)	20%	100%*	8%
	Operator	54%	75%	41%
	Finance	12%	18%	8%
	Secretary	12%	18%	8%
	Other	3%	23%**	15%***

Note: *exceptional case, where the only O&M team is the head of the team who also acts as the operator; ** and ***,both sites are the only sites with additional staff as the payment collector.

Observations are made on the operational cost and remuneration structure related to the management team (UPT) as follows:

- In most of the villages, the remuneration structure for the management team is set as a percentage of the revenue. Only in Leppan, and in Saluburononan the remuneration of the staff are regulated as a fixed amount for each position.

  All the communities surveyed are collecting more revenue than they are disbursing in operational costs (Exhibit 2.5, cost component no. 1). On average the operating profit registered by the communities is 35% which appears to be a solid figure. In all case this money is placed in a reserve fund to cover unforeseen eventualities and major future expenses.
- The vast majority of operational costs (some 79%) relate to staffing expenses with the remainder being used to cover small scale operations and maintenance items.
- In terms of how these different staff members are remunerated, the majority of funds is provided to the operators indicating a positive sign.
- The limited amount of operational cost data that could be collected again portrays a fairly positive view of the PNPM systems. In particular, the fact that a significant proportion of revenues are being kept in reserve to deal with major eventualities is a very good sign that the systems will be sustainable.

2.2.2 Record keeping

During the survey, it was observed that villages that have already established proper tariff and management team (UPT) are mostly aware of the importance of keeping revenue and expenses records. In the villages supported by TSU, the community received uniform formatted notebook for book keeping of revenue and expenses related to MHP operation. However, level of details in book keeping varies across villages although most of them in general keeps revenue and expenses records, and customers are provided with subscription cards. In Mesakada, level of records is more detailed compared to other villages. In addition to records on revenue, Mesakada villages distinguished tariff classes based on electronic equipment per customer, and historical data of customer using different type of appliances according to tariff class is recorded properly. This record keeping has facilitated them in reviewing the village electricity demand and conduct simple for tariff adjustment. Based on the interview, Mesakada village has already conducted tariff adjustment twice since the MHP was handed over to the village.

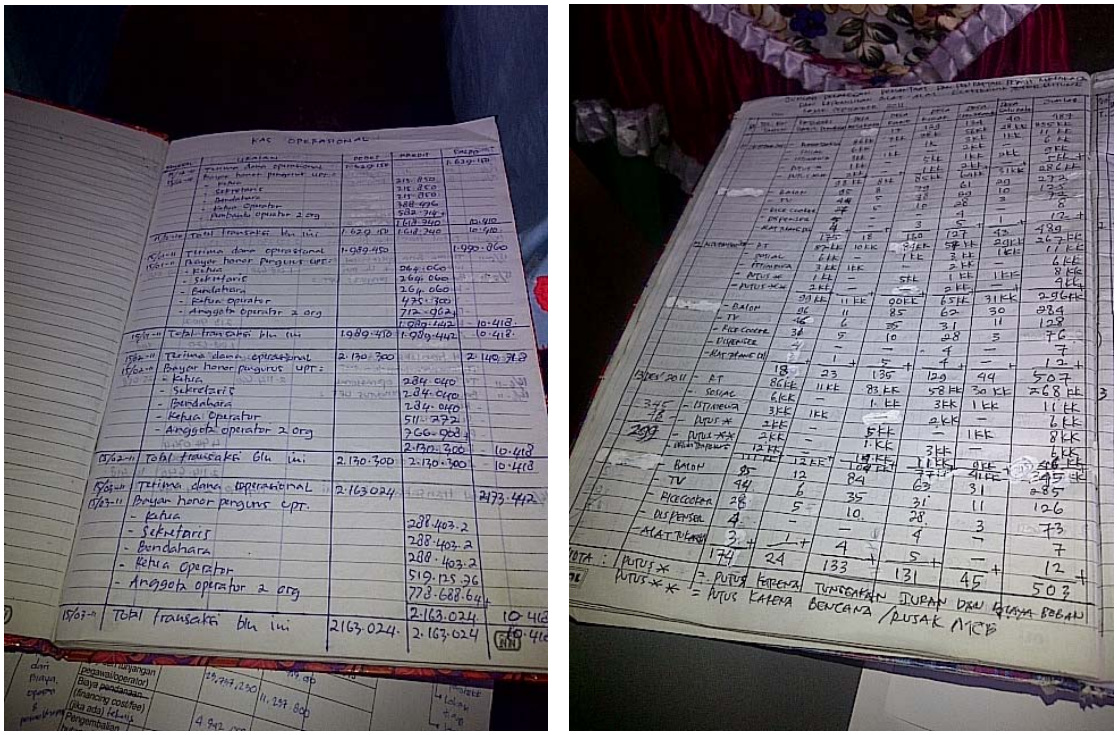
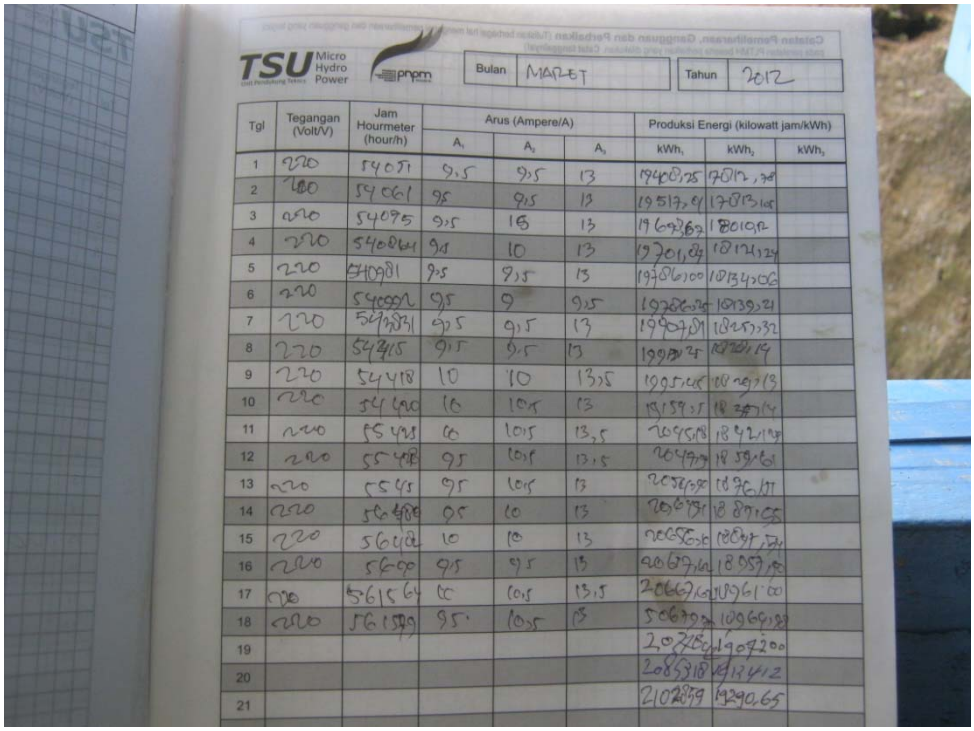


Exhibit 2.6: Book keeping, MHP operation, Mesakada Village

Technical records: Overall, the villages visited have low awareness in keeping technical records. Ideally, the power generated and the power consumed are to be monitored based on kWh meter reading from the control panel, and recorded regularly to check the MHP power output performance and the MHP load. Out of 15 villages visited, only Orabua Selatan village has kept records on power generation and power consumed. There is no log book seen regarding monitoring or control visit conducted by TSU or NMC representatives. Ideally, monitoring visits and activity conducted during visits should be recorded to ensure proper guidance and capacity building and strengthening to the village communities.



TSU Micro Hydro Power — pnpm

Bulan: MARET — Tahun: 2012

Tgl	Tegangan (Volt/V)	Jam Hourmeter (hour/h)	Arus (Ampere/A)			Produksi Energi (kilowatt jam/kWh)		
			A_1	A_2	A_3	kWh_1	kWh_2	kWh_3
1	220	54051	9,5	9,5	13	19408,75	17812,74	
2	220	54061	9,5	9,5	13	19517,91	17813,105	
3	220	54075	9,5	15	13	19623,63	18010,8	
4	220	54084	9,5	10	13	19701,84	18124,324	
5	220	54090	9,5	9,5	13	19786,100	18134,506	
6	220	54099	9,5	9	9,5	19788,36	18139,21	
7	220	54093	9,5	9,5	13	19907,81	18257,32	
8	220	54415	9,5	9,5	13	19925	18270,14	
9	220	54418	10	10	13,5	19951,08	18 [illegible]13	
10	220	54440	10	10,5	13	19 [illegible]	18 [illegible]	
11	220	55 [illegible]	10	10,5	13,5	20495,18	18 342,19	
12	220	55 [illegible]	9,5	10,5	13,5	20497,9	18 358,61	
13	220	5545	9,5	10,5	13	20538,38	18 376,11	
14	220	5546 [illegible]	9,5	10	13	20567,81	18 391,55	
15	220	5564 [illegible]	10	10	13	20655,36	18054,74	
16	220	5600	9,5	9,5	13	20667,16	18057,18	
17	220	56156	10	10,5	13,5	20667,16	18961,00	
18	220	56159	9,5	10,5	13	20678,20	18966,80	
19						20748,19	07200	
20						20853,18	19412	
21						21028,79	19290,65	

Exhibit 2.7 Power output and demand records, Orabua Selatan

2.2.3 Compliance with prevailing regulations

It is observed that the electricity tariff is set-up in each villages based on the consensus of the community, which was discussed with the head of the village and is officially authorize by the head of the village through “Village Regulation’ (*Peraturan Desa*). The village regulation is established by referring to the Regional Administration Governance Law (Law No. 29/1959 amended with Law No. 29/1999 with regards to decentralization law) and the funds transfer from central government to regional government (Law no. 25/1999) and does not refer to the Electricity Law.

The recently updated Electricity Law (Law No. 30/2009) specifically highlighted that power supply business shall be conducted upon receipt of a business license and District/City government can set tariffs for district/city appointed power supply licence holders. In view of the electricity law, the MHP operation at the village level should have been regulated under the District authority and should have received business license and the tariff is subject to approval of the district authority. In view of the interpretation of head of the village as the extension of the District administration government, the current tarrff set-up process may be acceptable

2.2.4 Operational Overview

Exhibit 2.8 summarizes the status of operational condition of MHP of PNPM Green. Observations made on operational information are made as follows:

- Although there is a wide difference between the largest and the smallest systems in the survey sample (both in terms of kW capacity number of households connected)) the majority of sites visited have an installed capacity of between 10 kW and 30 kW and approximately 100 connected households.

Exhibit 2.8 Operational Overview

No.	Operational Items	Average	Highest	Lowest
1	Installed capacity (kW)	22	78	6
2	Planned vs. installed capacity (kW)	10	118	-14
3	Number of HH connected to MHP	90	316	10
4	Number of connected HH per kW installed	4.5	7.7	1.0
5	Planned connected HH per planned kW	9.2	23.1	0.6
6	Number of planned minus actual HH connected:			
	Number	59	185	1
	% of planned	37%	90%	-3%
7	Number of connected HH as proportion total HH	61%	100%	14%
8	Output (kWh / month)	6,716	31,684	285
9	Output per kW vs. age of system:			
	≤ 6 month of operation	81	120	29
	> 6 months but ≤ 12 months operation	261	377	42
	> 12 months of operation	317	448	50
10	Output as proportion of total potential output	38%	93%	1%
11	Electricity consumption/month/household (kWh)	64	152	7
12	Average hours of operation	115	157	40
13	Average number months operation	12	27	3
14	Average distance from grid	9	28	1
15	O&M Cost proportion to total revenue (%)	13%	38%	3%
16	Monthly Reserve Fund proportion to total revenue	36%	56%	21%

- *Number of Household connected*: the average number of households connected per kW installed is 4.5 (no. 4, Exhibit 2.8). This figure gives an indication of whether the scale of the scheme is appropriate to the population that will use it. In grid connected systems in developed countries, the rule of thumb is between 1 kW and 2 kW per household and so for off-grid systems where households will have very few appliances, something like 25% of this figure may be considered appropriate. Therefore, something in the region of 2 – 4 households/kW would appear sensible. On this basis, the average figure looks reasonable but some of the higher figures (i.e. above 6 households per kW) may be undersized.

- *Electricity consumption pattern*: the average consumption per household per month is 64 kWh (No.11, Exhibit 2.8). Average UK electricity consumption per household is approximately 400 kWh per month. Applying the same 25% factor as above gives an average figure of 100 kWh. Whilst the sample figure may be skewed downwards somewhat by some low consumption levels registered by newly installed schemes, it may again point to some systems being undersized.

- *Actual vs planned electricity connection*: It is also interesting to compare the actual number of household connected to the installed system with what was planned (i.e. expected number of household connections divided by expected installed capacity – No. 5, Exhibit 2.8). The average number of planned household connections per kW is twice as high as has materialized (i.e. 9.2 vs. 4.5). Again this suggests that some of the planned schemes may be a little undersized. However, this average figure also conceals the fact that there are just as many cases in the survey of the planned figure being lower than what has materialized as there are higher numbers.

The planned versus actual number of household connections figure (No. 6 and 7, Exhibit 2.8) provides some cause for concern as on average there are 59 households that have failed to connect that were expected to do so. Whilst this average figue is skewed slightly upwards by one very large figure (185 for Mesakada) there are a number of cases where the figure is close to or above 100. Looked at another way, on average some 37% of planned household connections have failed to materialise and just 61% of households in the communities have a connection (with a low of 14% in one case). There may be some good reasons for this (e.g. the relative newness system) but the issue is of sufficient importance that it is discussed further in the section below.

- *Planned vs installed capacity*: In terms of planned versus installed capacity (No. 2 Exhibit 2.8), for most of the survey sample there was very little difference in the figures. The average figure, therefore, is skewed by one large discrepancy (118 kW for Pasaman). Without this figure the average difference falls to 1 kW. This issue is considered further in the section below.

- *Electricity output*: As may be expected the output levels recorded across the different systems varies widely – ranging from 285 kWh /month to 31,684kWh/month (No.8, Exhibit 2.8). This is partly a factor of the different sizes of the installed systems2 but perhaps more importantly it is a function of the age of system– as the schemes mature then so their levels of output also are seen to increase. Whilst this is generally the case, there are a couple of exceptions to this rule (e.g. Orabua Selatan and Buangin) that warrant further investigation as to their apparent operational difficulties.

- Examining the output issue from another perspective (no. 10, Exhibit 2.8), on average it appears that the micro hydro schemes are operating at 38% of their available capacity (with a median figure of 45%). An average figure close to 50% might be considered “normal” and so on this basis the performance of most systems would appear to be reasonably good. Indeed, in a number of cases the capacity factors are above 60% which is very positive.In terms of hours of operation (No. 12, Exhibit 2.7), the average figure recorded is 115 and the majority of sites sampled registered between 100 and 120 hours of operation per week. Given that there are 168 hours in the week, then this implies an average operational ratio of 68% (or over 2 whole days which can potentially be used for maintenance and rehabilitation activities) which appears encouraging.

- *Distance with PLN Grid*: the average distance from the PLN grid registered for the community sample is 9 kilometres which also looks to be a good sign (No. 14, Exhibit 2.8) – the PNPM scheme after all is supposed to target those communities that are unlikely to receive grid electricity any time in the short to medium term. This average figure, however, does conceal the fact that six of the fourteen villages surveyed are located four kilometres or less from the PLN grid. Indeed, one of the villages surveyed (Batu Basa) actually receives PLN service which would appear to be a serious violation of the objective of the PNPM program.

[2] It should also be noted that in the majority of cases little effort is made by the UPT to record and monitor output levels. A change in this practice should perhaps be encouraged so that more effective operational performance assessment may be carried out.

- *O& M Cost (non-staff):* The range of O&M cost (non-staff) proportion to total revenue is quite wide, from 3% to 38%, while the average is 13%. If we exclude Masoso, the range is from 3% to 17% which indicates exceptional regular O&M expenses included in Masoso. It is to be noted that the estimation only takes into account the regular maintenance cost such as lubricants and some small purchases for power house and M&E requirement (cables, lamps, etc).

- *Monthly Reserve Fund*: The monthly reserve fund proportion to total revenue is in average 36% where the maximum is 56% and the minimum is 21%. The range of the TSU site is 56% to 21% and the average is 33%. Non-TSU sites monthly reserve fund proportion to total revenue is in the range of 22% to 48% while the average is 37%. Thus, the share of monthly reserve fund to total revenue for both TSU and Non-TSU is comparable.

Overall, therefore, a positive assessment may be made of the operational status of the MHPs surveyed. The majority of schemes appears to be working well and, as discussed further below, is providing a valuable service to the communities. Some communities do appear to be experiencing some operational difficulties and there is a concern about the number of planned connections that fail to materialize. There is also a possibility that some schemes are somewhat under-sized, especially as evidence elsewhere in the world suggests that once a household receives stable electricity supply their power consumption increases dramatically.

2.2.5 Operational Issues

In this section, we briefly examine some of the issues highlighted in the operational assessment:

Planned vs Installed capacity: In a couple of cases (Alur Kejrun and Masoso) installed capacity was significantly below the FS forecast. (In two cases – Mesakada and Salutamban Barat – the installed capacity was slightly larger) This raises two questions – what was the reason for the change and should the construction have gone ahead given the smaller scale (i.e. could resources have been better applied elsewhere)? Addressing the first question, the reason for the change from the FS for Alur Kejrun may have be linked to its high capital cost and low in-kind community contribution. For Masoso the reasons are less clear. With regards to the second question, the high capital cost /kW and low connection rate presently evident at Alur Kejrun suggests that perhaps resources could have been allocated better elsewhere.

Number of actual connections materialized: In virtually all cases the number of planned connections in the FS exceeded the actual number of connections made. In some cases (Batu Basa, Mesakada, Bokin, Kare Penanian, Saluburonan and Leppan) there is a significant difference. This may partly be explained by the relative newness of the projects. The operation commencement dates for three of these six schemes (Batu Basa, Mesakada and Kare Penanian) began in mid 2012 and one may reasonably expect connections to increase over time. However, in some cases this is a cause for concern. In terms of trying to identify a pattern among these under-served communities, one needs to look at equity contribution, tariff rates, connection charges, the nearby presence of the PLN grid, etc. The evidence suggests that possible causes for the low connection rates in Bokin, Saluburonan and Leppan is the near proximity of the grid as well as the low in-kind contributions from these villages which is likely to be caused by the low annual incomes of the community members. Also, these communities enjoyed a lower PNPM block grant despite having a relatively large number of households which suggests that perhaps more resources could have been diverted to these communities to alleviate the problem.

Design failure at initial stage: It was found out in the survey that few sites (Batu Basa and Benteng Besi) suffer from very low water flow that cause either very low electricity generation or, at worst, cease of operation[3]. In other sites, it was found out that some of the water flow calculated at the design stage was used for irrigation purpose, creating lower power output. It appears that in these sites, the design of the expected output was not reflecting the actual condition of the water flow and did not take into account the expected surrounding activities which would influence the water flow, such as irrigation, or development of other MHP by other institution. In Batu Basa, which is supported by TSU, there might be an error during the preparation of the FS whilst in Benteng Besi, not supported by TSU, the project proposal was prepared by the community and only assisted by the NMC. A proper design that takes into account water flow in various condition and seasons, as well as surrounding activities is required to ensure proper operation of MHP.

Daily maintenance: in most sites visited, distance and the conditions between the power house, forebay and weir was not easily accessible which reflects that monitoring of the condition of the water flow and condition of the civil construction of the MHP were not conducted often. In few sites, debris was found at the intake and at the forebay screen, which results in low water flow creating low power generation.Civil construction at TSU-supported sites are generally in better quality compared to non-TSU supported sites. The construction quality allows better and easier daily operation, maintenance and cleaning. For example, the channel construction in Alur kejrun are strengthened by concrete on both sides, while in Saluburonan, only one side of the channel is strengthened by concrete (Exhibit 2.9 a and b).

Lack of control and monitoring equipment: only 4 sites out of 15 visited installed a kWh meter. Without kWh meter, the estimation of the kWh output conducted during the survey is only based on instantaneous Amperemeter and Voltmeter reading, which is likely not reflecting the actual output generated by MHP and used by customer. To ensure a sustainable operation, regular monitoring of power output is required to measure the MHP performance and for early detection of damage or failure. In few villages, MCBs to regulate load to each customer are not yet installed. In few sites, the control panel was in failure due to insects or technical failure (damage of fuse), and these are found in Non-TSU sites. This relates to the remarks made on the accessibility of MHP installation and construction (Power house, forebay, weir, channel, etc) that need to be maintained through regular maintenance. In sites not supported by TSU, there is no kWh meter installed.

[3] This happens in Benteng Besi. Currently, the village is electrified with Diesel Generation.

Exhibit 2.8: Damaged control panel, 2 years after commencement of operation

Exhibit 2.9a: Both Sides of Channel are Sthrengthened with Concrete, Alur Kejrun, TSU site

Exhibit 2.9b: Only One Side of the Channel is strengthened with Concrete, Saluburonan, Non-TSU site

Alternative to MHP: Based on the survey conducted in 15 villages, there are few alternatives to be considered for rural electrification: PLN grid, solar power and MHP of other scheme(s). In six of the fifteen villages surveyed are located four kilometres or less from the PLN grid, namely, Batu Basa, Bokin, Buangin, Timpuseng, Barugae and Saluburonan. It is likely that the lower actual number of connection compared to planned connection is influenced by the proximity to PLN Grid. Based on discussion with NMC, one of the conditions for MHP site selection is that the minimum distance o PLN grid is 2 km. Distance of Batu Basa is only 1 km and the number of household connected is only 10. Further implementation of MHP under PNPM Green must take into consideration not only the existing distance to the grid but also the electrification plan of the village in the next five years to ensure that the MHP will bring value added to the community.

Solar power and MHP developed by other institution are identified in Kare Pennanian village. The MHP was developed by an NGO, and it was just started to be put in operation about 6 months before operation of MHP PNPM green commenced. As a result, there is a lower number of household connected to MHP PNPM Green since more number of household were already connected to the other MHP. The Tariff imposed by the other MHP was IDR 5,000 lower than the MHP of PNPM Green. Solar power installed in this village was in operation since 2010 with the installed capacity of 5000 Wp. The solar panel serves about 32 household and is free of charge.

2.2.6 Revenue Overview

Exhibit 2.10 contains summary information in relation to some key revenue statistics. Most importantly of course, as noted in the previous section, is that fact that revenues are covering operating costs in all the systems (except for Buangin where a tariff system has not yet been established).

Exhibit 2.10 Overview of Revenue Components from Electricity Sales

No.	Revenue component	Average (IDR)/month	Max (IDR)/month	Min (IDR)/month
1	Total Revenue	1,337,866	3,290,000	300,000
2	Revenue/kWh	561	2,256	84
3	Revenue/Household	18,076	37,000	5,944
4	Baseline tariff	14,354	35,000	1,600
5	Connection fee (one-time payment, not monthly)	172,308	550,000	0

Observations made in relation to the data presented in Exhibit 2.10 are as follows:

- The total annual revenue from electricity sales figures (No.1) vary quite widely although interestingly there is no correlation between the magnitude of the revenue collected and the degree of cost coverage. This is because the smaller schemes that register only limited revenues (e.g. Batu Basa and Kare Penanian) also have relatively low costs.

- The revenue/kWh figure registers the total revenue collected per month divided by average output produced per month and is therefore a rough proxy for a per kWh tariff (in contrast to the flat fee tariff rates that each community levies on each household irrespective of level of consumption). The figure varies considerably across the communities which reflect a number of factors including the different output rates of different schemes, the different tariff levels and structures applied (i.e. number of tariff bands, connection fee, etc.) as well as the number of customers. Some further analysis on this figure might usefully reveal whether there any lessons to be learnt from the different tariff approaches applied in the surveyed communities. As actual kWh delivered could not be observed in majority of the village visited due to lack of proper recording and kWh meter[4], valid observation could not be drawn for further analysis on tariff/KWh.

- In contrast, the revenue per household figure (No. 3) does not vary considerably which as might be expected given the flat fee structure that is applied in all communities. The result of this is that the majority of households in each community pay the same basic tariff.

- The basic flat tariff levied (No. 4) on households ranges from IDR, 1,600/month to IDR 35,000 per month (with additional tariff increments of usually IDR 5,000/month applied as households connect more appliances). If we exclude Masoso, than the

[4] kWh meter only observed in Alur Kejrun, Pasaman, Orabua Selatan and Bokin.

range of the basic flat tariff is IDR 5,000 t0 IDR 35,000[5]. The average basic tariff is Rp. 14,000 which compares favorably to the PLN tariff which typically ranges from Rp. 40,000 – 60,000 per month[6].

- Only six of the fourteen villages surveyed levies a connection charge on its households (No. 5) and this amount varies between IDR 550,000 (applied in four villages) and IDR 30,000 and IDR. 10,000 in the other two locations. A sizeable connection fee will, clearly, act as a deterrent to some households to connect and so perhaps a better policy would be to have require a minimum upfront equity contribution from each household that would then cover the cost of their connection once construction is completed. That said, even the maximum connection fee of IDR. 550,000 is considerably less than the PLN fee of IDR. 2,600,000.

Exhibit 2.11 illustrates the range of tariff applied in the sample survey. Based on the three sites observed in Sumatera and ten sites observed in Sulawesi, the Tariff applied in Sumatera is slightly higher than in Sulawesi.

Exhibit 2.11 Range of Tariff Applied

Sites	Base Tariff (IDR)/month	Maximum Tariff (IDR)/month	Remarks
Sumatera			
Alur Kejrun	20,000	30,000	
Marapan	35,000	55,000	
Batu Basa	20,000	40,000	
Sulawesi			
Mesakada	10,000	30,000	
Masoso	1,600	26,500	
Salutambun Barat	5,000	15,000	
Orabua Selatan	10,000	20,000	
Bokin	20,000	30,000	
Buangin	0	0	tariff is not yet applied during the survey
Kare Penanian	15,000	-	Single tariff is applied
Timpuseng	15,000	35,000	
Barugae	20,000	30,000	
Saluburonan	10,000	30,000	
Leppan	5,000	10,000	

[5] Masoso applies tariff for each specific electricity appliances and for each watt of lighting installed. Therefore, the payment of each household varies according to type of electricity appliances that they have and the wattage of lighting installed

[6] PLN also levy a fixed charge per month on its customers. For small consumption customers, as is the case here, this fixed fee is presently IDR 11,000 / kVA / month

2.3 FINANCIAL ANALYSIS

A simple cash flow analysis was conducted on the revenue and cost data collected for each community (except for Buangin where such information did not exist) with an associated twenty year forecast. A net present value (NPV) calculation was then applied to the net cash flow figures with the following assumption:

- Discount factor of 10%
- Operational cost inflation of 5%
- Annual Escalation of tariff and fuel cost of 7%
- Project life of 20 years.

The results of this analysis are presented in Exhibit 2.12.

Exhibit 2.12 Net Present Value Calculation

No.	Villages	NPV - Basic Operation (IDR)	NPV - Fuel Saving Included (IDR)
TSU			
1	Alur Kejrun	-431,141,100	52,470,968,990
2	Marapan	-250,305,589	62,459,420
3	Batu Basa	-393,021,893	-172,904,426
4	Mesakada	-1,466,476,391	7,452,462,194
5	Masoso	-386,875,183	1,185,422,630
6	Salutambun Barat	-486,476,896	1,354,199,722
7	Orabua Selatan	-378,575,663	-339,707,337
8	Bokin	n/a	n/a
9	Buangin	-389,263,636	-389,263,636
10	Kare Penanian	-351,516,048	211,051,828
	Average TSU	-541,838,959	8,858,985,885
	Max TSU	-250,305,589	52,470,968,990
	Min TSU	-1,466,476,391	-339,707,337
Non-TSU			
1	Timpuseng	-244,562,551	850,569,580
2	Barugae	-319,763,775	625,350,256
3	Saluburonan	-84,498,145	2,691,041,278
4	Leppan	87,105,763	889,020,698
	Average Non-TSU	-140,429,677	1,263,995,453
	Max Non-TSU	87,105,763	2,691,041,278
	Min Non -TSU	-319,763,775	625,350,256
	Overall		
	Average	-391,951,624	5,145,436,246
	Max	87,105,763	52,470,968,990
	Min	-1,466,476,391	-389,263,636

What this analysis reveals is that with just one exception (Leppan, a Non-TSU site), none of the communities surveyed is able to deliver a positive NPV on the basis of its current operating revenue and cost profile. The NPV of all TSU supported sites yields in negative value when the fuel cost saving is not factored in the calculation. What this means is that, from a purely financial point of view, the capital cost incurred in developing the micro-

hydro schemes in these communities does not produce a viable return. This, in turn, means that a rational investor would not undertake such an investment. It is to be noted that the O&M cost factored in the calculation is only based on the actual O&M regular maintenance cost, not including a major repair such as generator replacement[7].
This result is as one would expect – micro hydro schemes in rural communities are not expected to be profitable investments. That is why the government needs to step in and provide grant funding in the first place. Indeed what is surprising is that one of them, a non-TSU site, is apparently is a viable investment. This might due to lower capital cost incurred in that site as some of the civil works materials e.g., weir, forebay, are cheaper than other sites.

However, when fuel cost savings enjoyed by the community are factored into the equation, the NPV values mostly become positive (with just three exceptions). This indicates that for the majority of communities the PNPM schemes deliver significant cost benefits.

If an attempt was made to quantify the intangible benefits and factor this into the financial analysis then, it might likely yield in positive NPV figures for each and every community.

[7] Considering that most of the MHP operation is quite recent (the longest is only 2 years), no significant operational cost was seen during the site visit (except for Buangin and Leppan)

3. SOCIO-ECONOMIC IMPACT ANALYSIS

This chapter describes the socio-economic impact of MHP development received by the village communities. This covers (i) the tangible benefits (or costs) measured by the actual cost savings (or costs incurred) as a result of the onset of the PNPM Green MHP, which is in principal is the actual cost saving from displacement of fossil-fuel based energy; (ii) the intangible benefit that accrue to villagers but cannot be readily measure, and (iii) the environmental benefit due the reduction of the GHG emission by displacing fossil-fuel based energy (kerosene, diesel and/or gasoline).

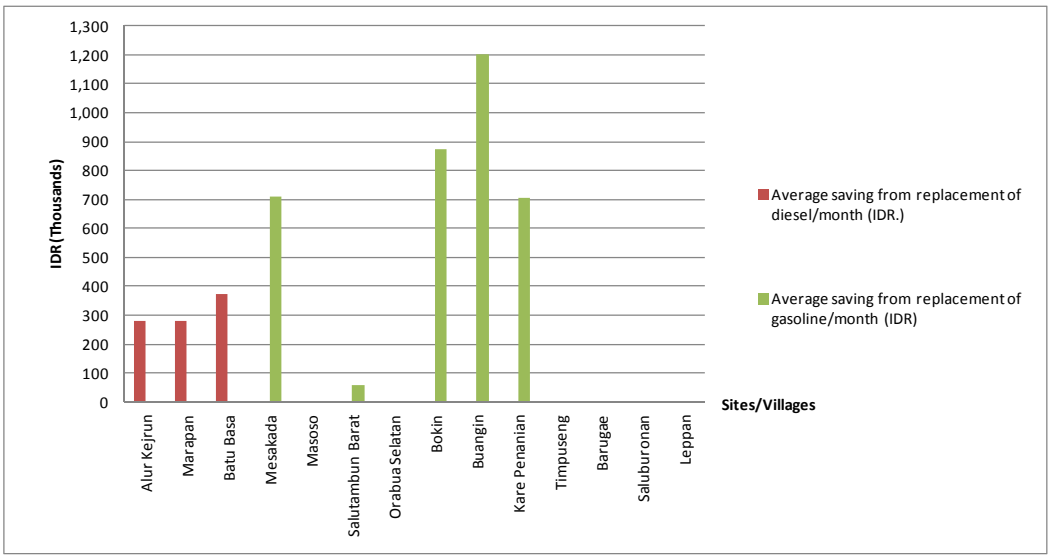
3.1 FUEL SWITCHING IMPACT

The main tangible cost benefits enjoyed by the communities are the fuel cost savings deriving from avoiding expenses for kerosene, diesel or gasoline. The most significant of these benefits are enjoyed by the (few) households who have historically been utilizing gasoline or diesel fuelled generators[8]. Exhibit 2.1 illustrates the average fuel cost savings in the villages visited and Exhibit 2.2 portrays the fuel cost savings incurred in each village. The analysis is based on the monthly-based data to ensure the consistency of the comparative analysis across the survey sample because commencement date of the operation and starting date of revenue collection vary across the survey sample. When the field visit was conducted, there were some sites that have had been operated for slightly more than two years and had two-year period revenue data while some others have had just started the operation only six month or less prior to the visit.

Exhibit 3.1 Average Monthly Fuel Cost Savings

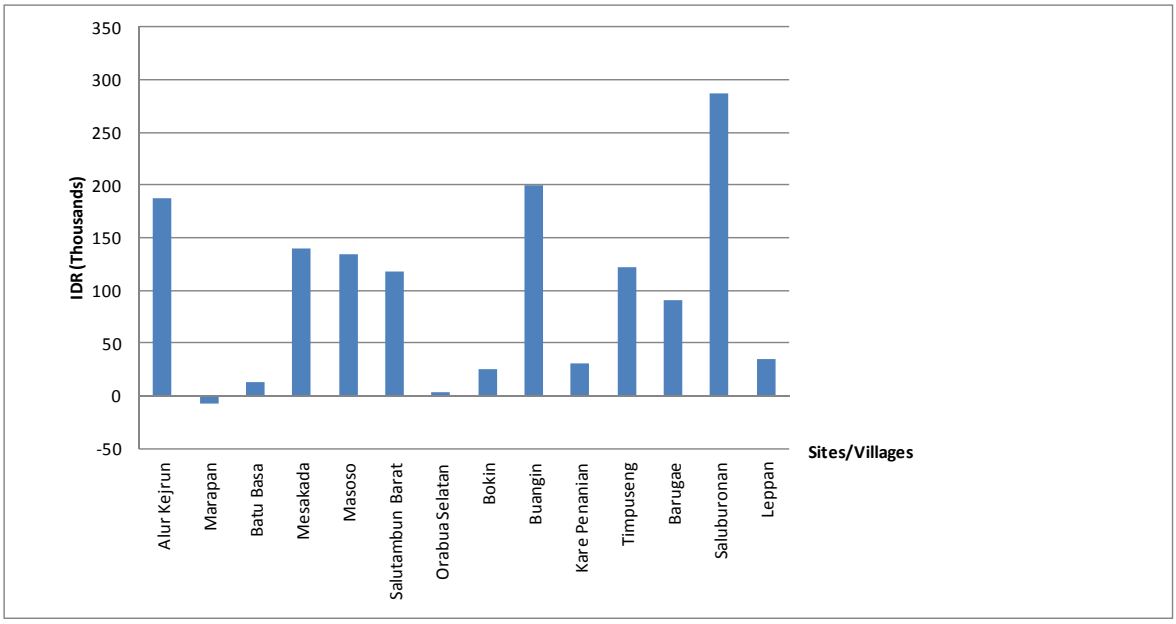
No	Fuel type	Monthly fuel cost savings (IDR)		
		Average	Max	Min
1	Kerosene	98,422	287,315	-7,000
2	Diesel	66,345	372,500	0
3	Gasoline	253,621	1,200,000	0

Exhibit 3.2 a. Cost Saving from Diesel or Gasoline Displacement (IDR)



[8] A diesel or gasoline power generation in average serves three households.

Exhibit 3.2 b. Cost Saving from Kerosene Displacement (IDR)



Every household in the communities surveyed uses kerosene. Although the average monthly bill for using this fuel is not very large, when multiplied across every household that receives an electricity connection the figure does become significant. Interestingly, some households, such as those in Marapan, end up paying more for their monthly electricity bill than they spent on kerosene. However, this additional cost brings with it some considerable benefits including no longer having to carefully limit the use of kerosene for lighting purposes and the avoidance of having to secure a kerosene supply. This, combined with the associated intangible benefits (described below) mean that all the households surveyed that pay more for electricity than they did previously for kerosene are very happy to do so.

3.2 INTANGIBLE BENEFITS AND COST

The intangible benefits enjoyed by the surveyed communities are many and varied. These benefits have not been formally quantified but they are no doubt of significant value and include the following:

- *Increased income from the productive use of electricity*: in many villages, economic benefit is seen through additional productive use of electricity after daytime. In Alur Kejrun, a female elementary school teacher is now able to *prepare traditional foods/cakes* in the evening for selling and she received about IDR 30,000/week. In Salutambun Barat and Bokin, some households are *initiating pilot chicken and pig farming* after the village is electrified with MHP, while communities in Kare Pennanian, Mesakada, and Saluburonan are discussing possibilities of using the electricity from MHP for *developing traditional carpentry activities* in the evening which earlier was produced by using Diesel/gasoline generator set. In Masoso, there is a new photocopy service subscribing to electricity access from MHP (special tariff applied). Shops in villages also enjoys increased income due to longer shop opening hours and shop customers take delight in increased convenience from being able to shop for longer periods.

- *Improved quality of life through longer and better quality of lighting*: All households agree that quality of lighting of lamps is much better than kerosene lamps, enabling them doing productive activities which were not used to be conducted in the evening. Electricity access provides lighting for longer periods of time, giving advantage for children to study at night. An interview with the village secretary of Leppan village, who is also working as secondary school teacher, testifies increased number of students (about 80%) that pass final exams after the MHP was put into operation.

- *Increase access to information and entertainment facility*: it is noticed that television and radio are the electricity equipment sought after by households with new electricity access. These appliances brought wider access of information and knowledge, as well as entertainment for leisure time.

- *Access to electricity for public facility*: In all sites visited, both TSU-supported or non TSU-supported, mmost of public facilities such as schools, places of religious worship (mosques and/or curch), clinics are benefiting from free-of-charge electricity access from MHP.

Exhibit 3.3 socio-economic Benefit: Longer Study Period and Wider Access to Information

Taken together the tangible and intangible benefits enjoyed by the communities that have received an electricity supply are considerable. It should also be noted that each and every household surveyed expressed their sincere gratitude to the PNPM program for providing them with an electricity supply.

3.3 ENVIRONMENTAL BENEFIT

MHP provides a clean alternative energy sources as the power generated does not produce Greenhouse gas (GHG) emissions. By replacing fossil fuel (kerosene, diesel and Gasoline) which earlier used in villages for electricity generation, MHP reduces the GHG emissions which would have been emitted. Exhibit 3.4 provides monthly estimation of GHG reduced from replacement of kerosene, diesel and gasoline by MHP and estimated annual GHG reduction for each village for sites supported by TSU, the average estimated annual GHG reduction from fossil fuel displacement is 2144 kg of CO2/annum while that of Non-TSU supported sites is 565 kg of CO2/annum. It is observed that the TSU sites enjoys more significant reduction of GHG emissions because communities in TSU-supported sites consume more fossil fuel consumption (not only kerosene, but also diesel or gasoline generator set are identified). The Non-TSU sites visited only displaces kerosene with MHP. In one of these non-TSU sites, Saluburonan, the gasoline generator

is used for carpentry and the use is not yet displaced by electricity from MHP because additional load from carpentry demand could not be met by the current MHP generation. The highest reduction was materialized in Saluburonan from kerosene reduction, while the lowest reduction took place in Orabua Selatan. GHG reduction from Diesel or gasoline is higher because, in average, one diesel or gasoline genset serves 3 (three) households, and the amount of GHG reduced is proportionate to the amount of kerosene and/or Diesel and or Gasoline displaced.

Exhibit 3.4 GHG Emission Reduction from Fossil Fuel Displacement

No.	Sites/Village Name	GHG reduction from Kerosene/ month (kg)	GHG reduction from Diesel/ month (kg)	GHG reduction from gasoline/ month (kg)	Estimated annual GHG reduction from fossil fuel (kg of CO_2/annum) month (kg)
TSU					
1	Alur Kejrun	40.4	82.1	n.a	1469
2	Marapan	9.8	145.9	n.a	1869
3	Batu Basa	14.5	206.5	n.a	2652
4	Mesakada	40.4	n.a	271.3	3739
5	Masoso	53.8	n.a	n.a	646
6	Salutambun Barat	43.0	n.a	22.6	788
7	Orabua Selatan	2.7	n.a	n.a	32
8	Bokin	13.5	n.a	203.4	2603
9	Buangin	53.8	n.a	271.3	3901
10	Kare Penanian	40.4	n.a	271.3	3739
Average estimated annual GHG reduction					2144
Max estimated annual GHG reduction					3901
Min estimated annual GHG reduction					32
Non-TSU					
1	Timpuseng	40.4	n.a	n.a	484
2	Barugae	53.8	n.a	n.a	646
3	Saluburonan*	80.7	n.a	n.a	969
4	Leppan	13.5	n.a	0.0	161
Average estimated annual GHG reduction					565
Max estimated annual GHG reduction					969
Min estimated annual GHG reduction					161

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4. CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

The overall assessment of the PNPM Green scheme on the basis of the survey carried out in this project is a very positive one. There are a number of very strong features to the program including the following observations:

- The majority of the schemes appears to be operating well and is providing a highly valued service to the community. The schemes are also being properly supervised as evidenced by the existence of formal records, progress reports and a management / operations team.

- The overall quality of most of the MHP schemes, both TSU and Non-TSU, are in general in good conditions as the schemes are quite recently built. The average number of actual household connected compared to the planned number of connection is about fifty percent less which might indicate undersized of the design or availability of other alternative energy services such as PLN grid. Quality of power delivery seems meeting the community requirement but actual review of delivery of power could not be observed due to lack of monitoring and recording of power output. It is observed that in the TSU-supported sites, communities are better prepared in monitoring and manage revenues and expenses of MHP as well as the daily operation of MHP, e.g, recording of kWh meter is only found in a TSU-supported site. In few supported TSU sites, control panel is equipped with kWh meter that allows better MHP performance monitoring. In Non-TSU sites, in a non-TSU site, major repair is identified due to lack of proper load control of the generator set. Lack of maintenance for accessing MHP installation and construction, and lack of record keeping are identified in some schemes, both TSU and non-TSU sites. In non-TSU sites, due to less amount of block grant amount, the civil construction quality in terms of material used is not as good as the TSU-sites.
- The financial status of the program is also generally strong with revenues covering costs and sufficient funds usually left over to enable significant reserve fund savings to be made which materially enhances the sustainability of the scheme.

- The basic flat tariff levied on households ranges from IDR, 1,600/month to IDR 35,000 per month The average basic tariff is Rp. 14,000 which compares favorably to the PLN tariff which typically ranges from Rp. 40,000 – 60,000 per month

- Simple cashflow analysis suggests that without taking into account the fuel saving cost into the calculation and not considering major repair, most of the MHP schemes under PNPM Green, both TSU and non-TSU shows a negative NPV. This indicates that on a pure financial basis with the current tariff structure, these MHPs are not viable in generating financial return. Based on observation on 4 (four) sites, the NPV calculation of Non-TSU MHP sites indicates higher level of return compared to NPV calculation of TSU sites. However, the NPV calculation assumes that both schemes perform well for the duration of the project lifetime. In actual condition, this depends on the operation and maintenance quality. In non-TSU sites visited, discrepancy between design and actual capacity was identified, major repair needed

to be conducted due to overcapacity of the generator, and important monitoring devices (control panel) are not maintained well. These conditions might likely costs more than those in the TSU-supported sites and may further reduce the financial viability of the scheme.

- Many community households are able to enjoy significant fuel cost savings thanks to the electrification of their village. However, even in cases where a household's electricity bill is higher than their previous (kerosene) fuel cost, this does not pose a problem. On the contrary, the household is more than happy to pay the additional money as they value and appreciate the benefit received from longer periods and a significantly better quality of light.

- Table 4.1 summarizes the range of monthly reserve fund to total revenue, the operational cost to total revenue and number of staff of the maintenance team. By observing the variation of the cost to total revenue and the monthly reserve to total revenue, it could be initially deducted that those with higher ratio of monthly reserve fund and lower ratio of operational cost to revenue will be better prepared for enhancing the sustainability of MHP operation, i.e., maintaining the MHP operation for a longer term, particularly if the sites are equipped with a balanced number of staff. However, these would also depend on proper operational knowledge and training of the staff, and the implementation of regular operational (revenue and costs) and technical records of the MHP operation by the staff.

Table 4.1 Reserve Fund, No of Staff and Operational Cost

Sites	Monthly O&M cost (non staff) to revenues	Monthly O&M cost (staff included) to revenues	Monthly reserve fund/total revenue	No. of staff
Alur Kejrun	15%	61%	39%	1
Marapan	4%	44%	56%	5
Batu Basa	11%	50%	50%	5
Mesakada	12%	72%	28%	5
Masoso	38%	78%	22%	5
Salutambun Barat	14%	79%	21%	12
Orabua Selatan	16%	76%	24%	5
Bokin	4%	76%	24%	5
Buangin	0%	0%	0%	1
Kare Penanian	17%	47%	53%	5
Timpuseng	3%	61%	39%	5
Barugae	13%	63%	48%	8
Saluburonan	11%	78%	22%	5
Leppan	9%	63%	38%	5

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- In most of the communities surveyed, the advent of electric power has also resulted in enhanced economic benefits through, for example, shops being able to stay open

for longer and new business ventures being set up (e.g. baking, games rental). The expectation is that this economic productivity will only increase over time with the result that the income of the community will be significantly enhanced. It should be noted that there are also some (very limited) economic costs associated with the scheme. For example, there is a negative income impact upon those households that previously sold kerosene and other fuel. However these costs are significantly outweighed by the benefits incurred by (usually) the same households.

- The PNPM program has also brought significant intangible benefits to the villages. For example, the better quality of light enjoyed by connected households enables children to study for longer periods and also enhances the social interaction of the community. Other benefits include being able to enjoy cooled drinks, more convenient cooking facilities and enhanced leisure time through TV, DVD and music appliances.

- There are, of course, some problems with some of the schemes. Some causes for concern include: operational difficulties at a couple of sites, the possibility that some of the schemes may be under-powered, slowness in the pace of connecting some households and, in some cases, the near proximity of the PLN grid potentially undermining the longer term sustainability of the scheme.

4.2 RECOMMENDATIONS

Presented below are some recommendations concerning how the PNPM scheme may possibly be amended to try and further enhance its positive impact:

- the FS should include forecasts of revenues and costs which would provide some advance indication as to how profitable each scheme is expected to be and a benchmark that can be compared to at a later date.

- Although no significant operational problems are evident in most of the communities surveyed, there are some issues. For example, in Batu Basa the river flow is considerably below what was forecast in the FS with the result that power output is down by 40%. This seems odd as the Technical FS was recently carried out (July 2010) and states that no significant flow reduction in the summer months is to be expected. This suggests that either the present low flow is unusual or that the original FS was erroneous. If the latter, then this points towards a more robust technical approach being required. It is advisable that the hydrology data covers reliable rainfall data from modelling through meterological data from the local weather station and FGD with the local people. At the minimum, the data taken for estimating the water flow should take into account rainy season and dry season, although the ideal data requirement is a 10-year data of the same catchment area.

- A minimum distance (say 9 km) from the nearest PLN grid connection should be used as a fundamental criterion for deciding which villages should receive MHP infrastructure or not. This should be a mandatory criterion. Exceptions to this distance rule can be made when there are other mitigating factors (e.g. topographical conditions that preclude PLN from connecting the village to its grid).

- A last minute check should be undertaken before money is released to ensure that the village is still eligible to receive funding. This is important because there is usually a significant delay between completing the FS and the construction work getting underway

- The selection criteria used for choosing which village will receive PNPM support should also perhaps include some economic criteria such as level of equity contribution, value of current kerosene usage, etc.

- MHP infrastructure development should perhaps include extending connections to households (for which the household may be expected to pay in advance in the form of a cash/equity contribution) rather than simply ending with constructing a line to the village. In this way, the number of households actually connected should better match the forecast figure.

- More and better coordination with local PLN staff is required to avoid the problem[9] of a community receiving two means of electricity supply.

- It appears that visits of TSU staff to communities are quite rare (i.e. on average no more than twice a year). This is because there are too few TSU staff to cover all the villages under the scheme. The TSU staff provide a valuable service and some additional resources are needed.

- All MHP schemes, both TSU and non-TSU sites, require more frequent and regular monitoring, recording, particularly on proper control and loading to improve quality of energy delivery services and maintain the project scheme performance. Technical assistance from TSU and NMC team for monitoring post-MDST for few years after MDST is needed.

- The followings are the summary of lessons learned from TSU-supported sites, which may be adopted for Non-TSU sites:

    a. Better quality of civil construction allows easier regular operation, maintenance and cleaning
    b. Installation of proper control devices and monitoring of power generated allows better monitoring of the turbine and generator performance
    c. Proper recording and monitoring of revenue and cost items, including regular revenues, updated list of subscribers per tariff category, updated cost and expenses records, allow better management of monthly reserve fund contribution, of which a part of it could be spared for continuous operation and maintenance expenses.

- Capacity building to operator and community is important to enhance the sustainability of MHP operation. The type of training that could be provided to the operator is a combination of class/lecture, and practical on-site trainingthat covers the following subjects: (i) The basic principle of hydro power plant; (ii) The basic procedure of operate the power plant; (iii) The knowledge of maintenance the building and civil part (iv) The knowledge of maintenance Turbine and Generator

[9] It is not, of course, a problem for the village members who doubtless enjoy the option (and prestige) of having two electricity sources. However, it is a major problem in the sense that PNPM resources are scarce and therefore need to be put to best use.

include the electrical part; and (v) The Operation reporting system. The duration of a combined lecture and practical on-site training could last for three weeks, while regular checking an monitoring to measure training impact is advised to be conducted at least once a month in a consultative meeting, within three month.The type of training that could be provided to the community is to improve the community knowledge on components and calculation of operation and maintenance cost; and on their awareness to maintain water catchment to support the sustainability of the project. The training subjects of a typical community training for MHP operation are: (i) .Cost analysis of the hydro power plant; (ii) Hydrology awareness and (iii) knowledge on type of plants that protect catchment area and methods to protect catchment area.

- Table 4.2 provides a simple 'check list' for consideration prior to selecting MHP sites for block grant funding project or investment, to ensure the sustainability of the MHP operation.

Table 4.2 Simple "Check List' for Consideration Prior to Investing in MHP Program/Project(s)

Education of Communities	Before submission of an electrification proposal, communities should be educated as to the costs and benefits of various in options available e.g. micro-hydropower, solar, solar hybrid or grid connection
Project Proposals	A detailed project proposal should be submitted for all micro-hydropower projects. This should be revised and updated to form a full feasibility study before implementation proceeds. The substance of the project proposal and feasibility study is set out below.
Proximity to Grid	There should be a credible assessment of when grid is likely to be available and the minimum distance from the site to the existing or planned PLN grid is approximately 9 km. Ideally this should be based on discussions with PLN at the provincial level. Projects most likely to qualify would be those in remote areas with small load density such as in provinces of Maluku, Papua, Nusa Tenggara. No project proposal should be approves if grid is assesed to be available within 10 years of proposal date.
Size of Project	The planned hydro power project should be large enough to meet the calculated demand including household use and productive uses of power. The minimum project size should be 10 MW. The sizing of the project should be accompanied by credible load forecasts, flow and head measurement.
Economics of Project	The proposed project should be economically viable taking into account existing costs of lighting and power and projected tariff and a design life of ten years unless a longer time until grid connection is justified.
Equipment	The project proposal should include provisions to be included in bid documents such as qualifications of manufacturers; performance of equipment, warranty and manufacturer support during and after the warranty period, and proper monitoring equipment such as kWh meter. Ideally, a standard set of technical specifications applicable to all micro-hydropower projects should be developed. All projects shall

	be fully instrumented and have automatic load control.
Procedures for Implementation	The project proposal should detail what procedures are planned for implementation to ensure that the project is constructed on time, within budget and with adequate quality. The procedures should provide for specialist intervention at critical phases of the project such as: preparation of project proposal, preparation of feasibility study, issue of bid documents, evaluation of bids and commissioning
Procedures for Operation	The project proposal should include proposed procedures for operation, the proposed tariff based on initial estimated cost

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5. REFERENCES

Castalia Strategic Advisors, 2009. *Rwanda Electricity Sector Access Program*, March 2009

GIZ & Kementrian Energi dan Sumber Daya Mineral, 2011. *Best Practice Guideline: Off-Grid Micro-Hydro Power Schemes for Rural Electrification.*

GVEP International & Entec, 2011. *Assessment of Pico and Micro-Hydro Power Market in Rwanda*. December 2011

Khennas, S., and Barnett, A., 2000. Best Practices for Sustainable Development of Micro Hydro Power in Developing Countries. ITDG and the World Bank.

Mukherjee, M., and Banerjee, S.Gosh., SASDE, 2012. *Challenges of Promoting Rural Access through Renewable Energy: Sharing Some Observations from India*, February 2012.

PNPM & TSU, 2010. *Pembangunan Pembangkit Listrik Tenaga Mikro Hidro, Panduan Teknis untuk FT, FKL dan Pekerja Konstruksi PLTMH.*

PNPM, 2010. *Panduan Spesifikasi Teknis PLTMH untuk Proyek PNPM-LMP*

Scaling Up Renewable Energy Program (SREP), 2012. *Review of Additional Information on Investment Plan for Mali,* Intersessional Meeting of the SREP Sub-Committee, March 2012

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APPENDIX A: SITE VISIT SCHEDULE

Dates	Villages Visited
2-5 July 2012	Marapan village, Pasaman District and Batu Basa Village, Padang Pariaman District
5-8 July 2012	Aleur Kejreun Village, Aceh Selatan District
12-19 July 2012	Masakada village, Orabua Selatan village, Masoso village, Salutambun Barat village: Mamasa District; Timpuseng village, Barugae village: Maros District
	Lepan Village,Saluburonan Village, Tana Toraja; Bokin Village, Buangin Village, Karen Pennanian Village, Toraja Utara
30 July - 1 August 2012	Benteng Besi village, Lebong District

APPENDIX B: EXAMPLE OF SURVEY QUESTIONNAIRE

MICRO-HYDRO SURVEY INSTRUMENT

This questionnaire is the tool to be deployed during the survey in site visit and it is expected to be conducted as an interview. This questionnaire content is subject to the content reflected the Feasibility Study of the sites to be visited.

People to be interviewed: 8 people

1. Head of the village or the representative of the head of the village
2. The Operational and Maintenance team, minimum 2 people (including operator of MHP) (*Tim Pelaksana Pemelihara Prasarana*)
3. The construction team, minimum 2 people (Tim Pengelola Kegiatan, TPK)
4. Representative of Households (3 representatives households)

1. FINANCIAL (to be completed based on data from NMC, and interview with TPK and TP3)

1.1: Direct Project Capital Cost	
	Amount (Rp.)
Block Grant	
Equity (or cash contribution from community)	
Debt (if any)	
Project IRR or discount rate (from FS)	

1.2: Indirect Project Capital Cost	
	Amount (Rp.)
In-kind contribution	
Technical assistance	

1.3: Project Operation Costs (Rp.)				
	2010	**2011**	**2012**	**2013**

O&M expenditure				
Staff costs				
Financing cost (if any)				
Debt repayment (if any0				
Office costs				
Other cost				

1.4: Project Revenues (Rp.)				
	2010	**2011**	**2012**	**2013**
Total revenue				
Conectivity fee				
Electricity sales				
Other sales				
Tariff level: Commercial Residential Other				

1. OPERATIONAL ((to be completed based on interview with TPK and TP3)

2.1: MHP Overview				
	2010	**2011**	**2012**	**2013**
Generation capacity (kW)				
Operational capacity (kW)				
Energy production (kWh)				
Hours service / day				
Total energy consumption (kWh)				

Peak consumption (kW)				
Number potential customer				
Number connected customers: Commercial Residential Other				
Network length (m)				
Staff numbers: Management Operations Other				

2.2: Any major operational issues (e.g. service quality, breakdowns, seasonality)?

2.3: Please describe the management structure / approach for the scheme

2.4: What procedures / regulations exist?	
Operations manual	
Other procedures / documentation	

2.5: Does the scheme differ from the FS design in any way? (If Yes, explain below)

2.6: Any environmental monitoring / impact? Any documents required for environment safeguard?

2.7: Any energy sources displaced?

2.8: Any other energy sources present?

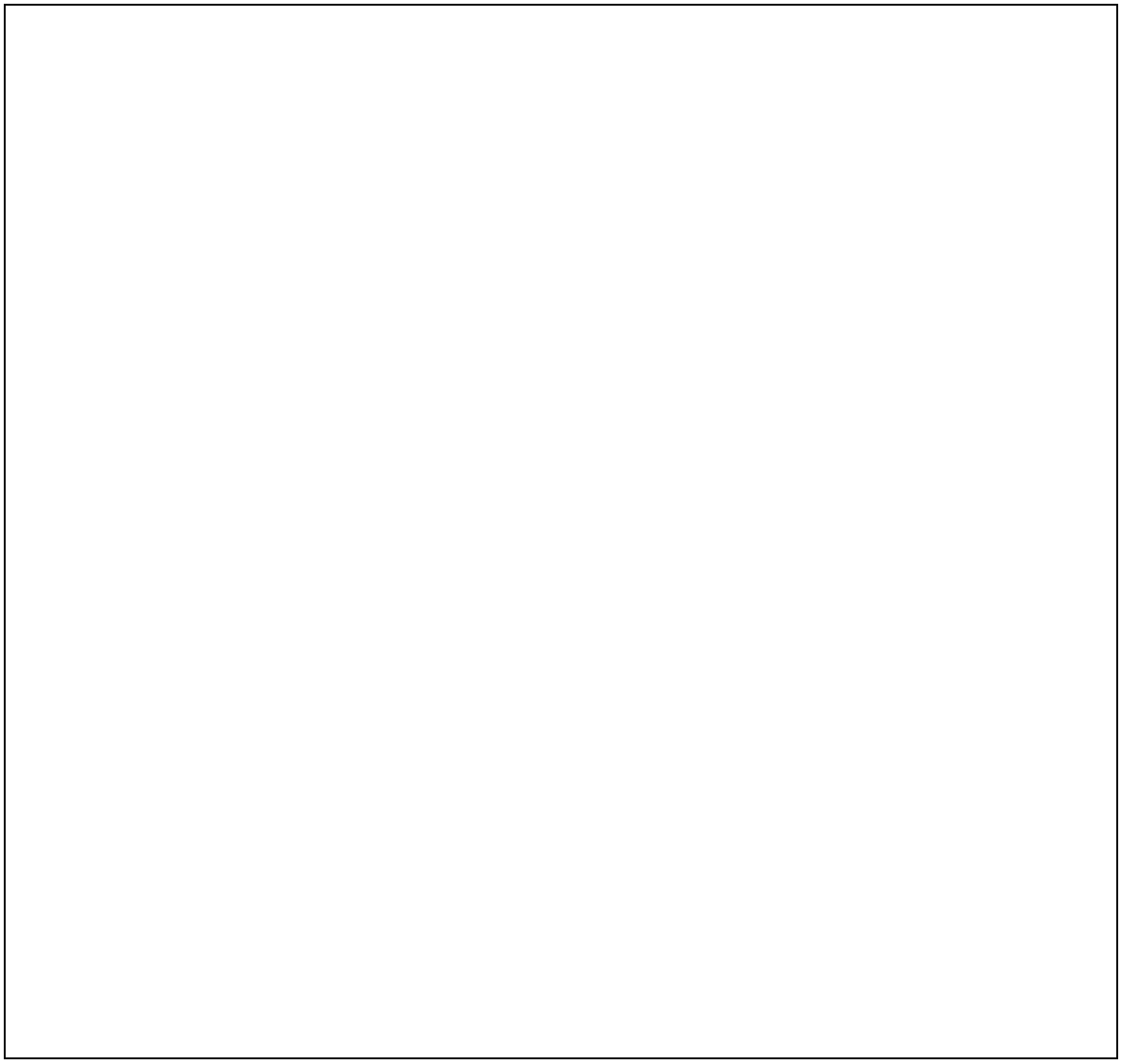
3.ECONOMIC/SOCIAL (to be completed by head of the village and household representatives)

3.1: What economic activity had resulted from the availability of electricity?

3.2: What impact has this had on community / household income?
- Income/household before installation of MHP: - Income/household after installation of MHP: - Any impact? describe

3.3: Has any economic activity been displaced? Any other negative impacts?

3.4: General customer views / feedback



APPENDIX C: SELECTED PICTURES

Community in Masoso Village

Interview in Leppan

Community in Saluburonan enjoying leisure time watching TV

Local Clinic Benefited Electricity Service from MHP, Kare Penanian

APPENDIX D: DATA SHEETS MHP VISITED

Alur Kejrun Village - Kecamatan Kluet Tengah

FINANCIAL	Number	% Total	Rp.	Total		Remarks
Capital Cost						
Total Capital Cost			642,063,000	642,063,000		This include civil works, M&E, networks, and greening, conservation of catchment area activity. The civil works, M&E and network costs IDR 429,780,000, and the remaining is UPK and TPK cost
Grant (Civil, M&E, Transmission Line, UPK, TPK)		71.9%	461,779,000	461,779,000		
Grant (Catchment area protection)		27.8%	178,221,000	178,221,000		
In-Kind Contribution - Assumed Balance		0.3%	2,063,000	2,063,000		
Operating Costs	**Number**	**% Net Revenue**	**Rp.**	**Monthly Total**	**2012**	
Expected Monthly O&M Costs			170,000	170,000		
Monthly Staff Costs						
Manager	1		500,000	500,000		The manager is also the operator.
Operator	-		-	-		
Finance	-		-	-		
Secretary	-		-	-		
Total	1	50%	500,000	500,000	6,000,000	
Total Monthly Operating Costs				670,000	8,040,000	
Tariff						
Basic Tariff	40		20,000	800,000		Approximate number. Few houses pay 30,000 because these houses have television.
Tariff Incremement			5,000			The tariff: IDR 20,000: 3 lamps, IDR 25,000: 3 lamps with VCD player, IDR 30,000: 3 lamps with VCD player and TV
Maximum Tariff	10		30,000	300,000		
Total Monthly Revenue				1,100,000	13,200,000	
Connection fee			30,000			
Monthly Reserve Fund Contribution				430,000	5,160,000	
OPERATIONAL						
Capacity (kw)	6.7					
Planned installed capacity	32.1					
Output (kwh) to Date	2,416					The comissioning was conducted on 4 April 2012, the MDST was conducted on 6 June 2012. Approximate operating hours to date (as of 6th of July 2012):
Implied Capacity Factor	16.5%					
Months of Operation	3					
Weekly Hours of Operation	108					operating hours/day: 14 hours (6 pm to 8 am)
Avg Output / Month (kwh)	805				9,664	
Avg Consumption / Month / Household (kwh)	16				193	
Population of Community						
Number of Households in Community	61					
Number of Household Customers	50					
Number of households planned to be connect	85					
Number of Staff	1					
Commissioning Date	04 April 2012					
MDST Date	06 June 2012					
Construction Start Date						
FS Date	Jun 2010					
ECONOMIC						
Avg Kerosene Consumption Litre / Month/household	15					
Kersone Cost Rp/Litre	14,000					
Households with Diesel Generator	3					6 HH were connected to Diesel genset which is generated by 3 household (1 genset serves 3 HH)
Avg Diesel Consumption Litre / Month	30					
Diesel Cost Rp/Litre	10,000					
Average Electricity Bill/month	22,000					
Average Kerosene Fuel Cost Saving/household	188,000					
Average Diesel Fuel Cost Saving/household	278,000					
Total Fuel Cost Saving / Month	8,542,000				102,504,000	
Historic Power Consumption (Rp. per HH)	600					
Other Benefit	increase income from selling cakes currently prepared in the evening, around 30,000 to 40,000 per week					
Distance to the nearest grid	25	km				
MCB	1	Ampere	the MCBs are only seen in few customers (less than 5 customers)			

PASAMAN DISTRICT - MARAPAN VILLAGE

FINANCIAL	**Number**	**% Total**	**Rp.**	**Total**	
Capital Cost					
Total Capital Cost			430,000,000	430,000,000	
Grant (Civil, M&E, Transmission Line, UPK, TPK)		89%	381,010,000	381,010,000	
Grant (Catchment area protection)			42,000,000	42,000,000	
Equity (A)	66	1%	50,000	3,300,000	
Equity (B)	13	0%	70,000	910,000	
In-Kind Contribution - Assumed Balance		10%		44,780,000	
Operating Costs	**Number**	**% Net Revenue**	**Rp.**	**Monthly Total**	**2012**
Expected Monthly O&M Costs			100,000	100,000	1,200,000
Monthly Staff Costs					
Manager	1	7%	174,300	174,300	
Operator	2	14%	362,600	362,600	
Finance	1	5%	129,500	129,500	
Secretary	1	5%	120,785	120,785	
Total	5	31%	787,185	787,185	9,446,220
Teacher Incentive		10%	249,000	249,000	2,988,000
Total Monthly Operating Costs				1,136,185	13,634,220
Tariff					
Basic Tariff	70		35,000	2,450,000	
Tariff Incremement	28		5,000	140,000	
Maximum Tariff			55,000		
Total Monthly Revenue				2,590,000	31,080,000
Monthly Reserve Fund Contribution		59%	1,469,100	1,453,815	17,445,780

OPERATIONAL		
Capacity (kw)	11	
Planned installed capacity	129.1	
Output (kwh) to Date	4,592	
Implied Capacity Factor	14%	
Months of Operation	4	
Weekly Hours of Operation	148	
Avg Output / Month (kwh)	1,148	13,776
Avg Consumption / Month / Household (kwh)	16	197
Population of Community	437	
Number of Households in Community	70	
Number of Household Customers	70	
Number of households planned to be connecte	80	
Number of Staff	5	
Commissioning Date	Mar 2012	
MDST Date	Jun 2012	
Construction Start Date		
FS Date	Jun 2010	
Distance from PLN grid (km)	3	

ECONOMIC		
Average Electricity Tariff / Month	37,000	
Avg Kerosene Consumption Litre / Month	4	
Kersone Cost Rp/Litre	8,000	
Households with Diesel Generator	10	
Avg Diesel Consumption Litre / Month	53	
Diesel Cost Rp/Litre	6,000	
Average Kerosene Fuel Cost Saving / Month	-7,000	
Average Diesel Fuel Cost Saving / Month	278,333	
Total Fuel Cost Saving / Month	2,307,333	27,688,000
Historic Power Consumption (Rp. per HH)	50,000	
Other Benefit	50% increase in shop transactions	

HOUSEHOLD SURVEY	**K Litres/Mth**	**K Rp.**	**K Total**	**D Litres/Mth**	**D Rp.**	**D Total**	**Elect Bill/Mth**	**+ / -**
Household 1 (Farmer)	3.13	8,000	25,000	-	6,000	-	35,000	-10,000
Household 2 (Farmer)	3.75	8,000	30,000	-	6,000	-	35,000	-5,000
Household 3 (Farmer)	4	8,000	32,000	-	6,000	-	35,000	-3,000
Shop 1	3.75	8,000	30,000	60	6,000	360,000	40,000	350,000
Shop 2 (& Café)	-	-	-	50	6,000	300,000	40,000	260,000
Shop 3	-	-	-	50	6,000	300,000	45,000	255,000
AVG	4		29,250	53		320,000	38,333	
Kerosene Avg Saving			-7,000					
Diesel Avg Saving			278,333					

PARIAMAN DISTRICT - BARU BATA BASA VILLAGE

FINANCIAL	**Number**	**% Total**	**Rp.**	**Total**		
Capital Cost						
Total Capital Cost			541,153,000	541,153,000		
Grant (Civil, M&E, Transmission Line, UPK, TPK)		96%	521,119,000	521,119,000		
Grant (Catchment area protection)		2%	10,017,000	10,017,000		
Equity		0%	-	-		
In-Kind Contribution		2%	10,017,000	10,017,000		
Operating Costs	**Number**	**% Net Revenue**	**Rp.**	**Monthly Total**	**2012**	
Monthly O&M Costs (Assmpn)		11%	33,000	33,000	396,000	
Monthly Staff Costs (Assmpn)						
Manager	1	9%	27,000	27,000		
Operator	2	16%	48,000	48,000		
Finance	1	7%	21,000	21,000		
Secretary	1	7%	21,000	21,000		
Total	5	39%	117,000	117,000	1,404,000	
Total Monthly Operating Costs		50%		150,000	1,800,000	
Tariff					-	Note:
One-Off Connection Fee	10		550,000	5,500,000		PLN Connection fee is Rp. 2,600,000
Number New Connections / Month (Assmpn)	1		550,000	550,000		
Basic Tariff (per MCBU)	10		20,000	200,000		PLN Tariff ~ Rp. 40,000 - 60,000 / month
Tariff Incremement (per MCBU)	5		20,000	100,000		
Total Monthly Revenue				300,000	3,600,000	
Monthly Reserve Fund Contribution		50%		150,000	1,800,000	
OPERATIONAL						
Capacity (kw)	10					
Planned installed capacity	-					
Output (kwh) to Date	1,140					
Implied Capacity Factor	4%					
Months of Operation	4					
Weekly Hours of Operation	157					
Avg Output / Month (kwh)	285				3,420	
Avg Consumption / Month / Household (kwh)	29				342	
Population of Community						
Number of Households in Community	70					
Number of Household Customers	10					
Number of households planned to be connecte	100					
Number of Staff	5					
Commissioning Date	Mar 2012					
MDST Date	Jun 2012					
Construction Start Date	May 2011					
FS Date	Jul 2010					
Distance from PLN grid (km)	1					
ECONOMIC						
Average Electricity Tariff / Month	30,000					
Avg Kerosene Consumption Litre / Month	5					
Kersone Cost Rp/Litre	6,000					
Households with Diesel Generator	4					
Avg Diesel Consumption Litre / Month	75					
Diesel Cost Rp/Litre	5,333					
Average Kerosene Fuel Cost Saving / Month	12,400	Assuming justa single connection for those presently without a connection				
Average Diesel Fuel Cost Saving / Month	372,500					
Total Fuel Cost Saving / Month	1,614,000				19,368,000	
Historic Power Consumption (Rp. per HH)	120,000					
Other Benefit	30% increase in shop transaction (one shop that is electricifed)					

HOUSEHOLD SURVEY	**K Litres/Mth**	**K Rp.**	**K Total**	**D Litres/Mth**	**D Rp.**	**D Total**	**Elect Bill/Mth**	**+ / -**	**PLN Bill/Mth**
Household 2 (Farmer)	4	6,000	24,000	-	-	-	20,000	4,000	40,000
Household 3 (Farmer)	4	6,000	24,000	-	-	-	N/C	-	
Household 4 (Farmer)	5	6,000	30,000	-	-	-	N/C	-	20,000
Household 5 (Farmer)	7	6,000	42,000	-	-	-	N/C		
Household 6 (Farmer)	7	6,000	42,000	-	-	-	N/C		
Shop 1	-	-	-	90	5,333	480,000	40,000	440,000	
Household 1 (Farmer)	-	-	-	61	5,333	325,000	20,000	305,000	50,000
AVG	5		32,400	75		402,500	26,667		
Kerosene Avg Saving			12,400						
Diesel Avg Saving			372,500						

Name of the village: Mesakada Village-Mehalaan Sub-district, West Sulawesi
Installed capacity: 78 kW

FINANCIAL	**Number**	**% Total**	**Rp.**	**Total**			**Remarks**
Capital Cost							
Total Capital Cost			2,128,000,000	2,128,000,000			Physical construction: IDR 1,953,720, UPK: IDR 15,425,000, TPK, 30,849,000
Grant (Civil, M&E, Transmission Line)		91.6%	1,950,000,000	1,950,000,000			
Grant (Catchment area protection)		2.3%	50,000,000	50,000,000			
In-Kind Contribution - Assumed Balance		6.0%	128,000,000	128,000,000			
Operating Costs	**Number (average/month)**	**% Net Revenue**	**Rp.**	**Monthly Total (estimated)**	**2011**	**2012 (January-May)**	
Estimated Monthly O&M Costs (taken from the monthly reserve fund)	12%			394,800	394,800		
Monthly Staff Costs							
Manager	1	9%	296,100	296,100			The manager is also the operator.
Secretary	1	9%	296,100	296,100			
Finance (*bendahara*)	1	9%	296,100	296,100			
Operator II	1	16.5%	542,850	542,850			
Operator II	1	16.5%	542,850	542,850			
Total	5	60%	1,974,000	1,974,000			
		0%	-	-		-	
Total Monthly Operating Costs				2,368,800	4,942,000	207,000	The revenue in 2011 is based on the total record in 2011 of Mesakada revenue report
Tariff							
Basic Tariff (3 lights)	299		10,000	2,990,000			The number of customer for each tariff is well recorded for each month
Tariff Incremement I (TV)	128		5,000	640,000			total customer as of July 2012; 321 households
Tariff increment II (Rice Cooker)	92		5,000	460,000			
Tariff increment III (Water dispenser)	10		5,000	50,000			
Tariff increment IV & V (Carpentry equipment	11		5,000	55,000			
Maximum Tariff	10		30,000	300,000			
Total Monthly Revenue				3,290,000	40,208,204	17,959,050	
Connection fee	5		10,000	50,000			
Monthly Reserve Fund Contribution (net, after deducted by estimated O&M cost)		28%		921,200			
OPERATIONAL							
Capacity (kw)	78.0						
Planned installed capacity	67.0						
Output (kwh) to Date	681,200						The comissioning was conducted on 30 September 2010, the MDST was in December 2010. Approximate operating hours to date (as of 13 July 2012): 13624 hour, based on operator record. The operational capacity is 50 kW
Implied Capacity Factor	56%						
Months of Operation	21.5						
Weekly Hours of Operation	132						Operating hours/day:15 hours, Wednesday, Friday and Sunday: 24 hours. Operating hours/week: 132 hours
Avg Output / Month (kwh)	31,684					380,205	
Avg Consumption / Month / Household (kwh)	100					1,203	
Population of Community							
Number of Households in Community	501						
Number of Household Customers	316						
Number of households planned to be connec	501						
Number of Staff	5						
Commissioning Date	30-Sep-10						
MDST Date	Desember 2010						
Construction Start Date							
FS Date	40,322						
ECONOMIC							
Avg Kerosene Consumption Litre / Month	15						
Kerosene Cost Rp/Litre	10,000						
Households with Petrol Generator	30						
Avg petrol consumption Litre / Month (genset)	120	720,000					
Petrol Cost Rp/Litre	6,000						
Average electricity bill/month	10,411						
Average Kerosene Saving / Month/household	139,589						
Average Petrol Cost Saving / Month/household	709,589						
Total Fuel Cost Saving / Month	52,834,684					#########	90 HH were connected to genset owned by 30 HH (1 genset serves 3 HH)
Average annual income/household, Rp.	1,200,000	Most of the people are cultivating cacao, coffee, and nilam					
Historic Power Consumption (Rp. per HH)	100,000						
Other Benefit	Additional time to work to produce carpentry						
Distance to the nearest grid	28	km					
MCB	2	Ampere					

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Name of the village: Masoso, Kecamatan Bambang
Installed capacity: 15 kW

FINANCIAL	**Number**	**% Total**	**Rp.**	**Total**		**Remarks**
Capital Cost						
Total Capital Cost			431,272,000	431,272,000		TPK: IDR 12,740,000 (approx 3%) TPK: 8,493,000 (approx. 2%)
Grant (Civil, M&E, Transmission Line, UPK, TPK)		98.3%	423,888,000	423,888,000		
Grant (Catchment area protection)		0.2%	784,000	784,000		
In-Kind Contribution - Assumed Balance		1.5%	6,600,000	6,600,000		
Operating Costs	**Number (average/month)**	**% Net Revenue**	**Rp.**	**Monthly Total (estimated)**	**Estimated 2012 (based on data january to June)**	
Estimated Monthly O&M Costs (taken from the monthly reserve fund)		37.9%	200,500	200,500		
Monthly Staff Costs						
Manager	1	3%	17,635	17,635		
Secretary	1	3%	17,635	17,635		
Finance (*bendahara*)	1	3%	17,635	17,635		
Operator I	1	15.0%	79,356	79,356		
Operator II	1	15.0%	79,356	79,356		
Total	5	40%	211,616	211,616		
			-	-	-	
Total Monthly Operating Costs				412,116	4,945,392	
Tariff	**No. of Customer (Average)**					Tariff class is divided into 9 category, of which each type electronic equipment has its own tariff for each household: regular radio , Rp 2,000/month; radio and CD, Rp. 3,000/month, TV 14 inch & CD: Rp. 5000/month; TV 21 inch & CD: Rp. 7500/month; TV more than 21 inch and CD: Rp. 10,000/month; electric iron: Rp. 5000/month; refrigerator: Rp. 50,000/month; Rice cooker: Rp. 100,000/month; lighting: Rp. 100/watt/month
Mixed tariff class	89	44		529,040		The fee reporting & records does not distinguish the above classes, thus, it is difficult to estimate the number of people with certain electric equipment. The fee records are just recorded lump-sum per household.
Basic tariff, tariff increment, max tariff	6,000	2,500	100,000			
Total Monthly Revenue				529,040	6,348,480	
Monthly Reserve Fund Contribution (net, after deducted by estimated O&M cost)		22%		116,924		
OPERATIONAL						
Capacity (kw)	30.0					
Planned installed capacity	54.4					
Output (kwh) to Date	83,349					the MDST was in January 2012. Approximate operating hours to date (as of 14 July 2012): 4167.45 hour, based on control panel information.
Implied Capacity Factor	27.6%					The installed capacity is 30 kW but the estimated design based on available flow is 22.2 kW, average peak wattage is 20 kW (based on information from operator, without record)
Months of Operation	14.0					There is no kWh meter
Weekly Hours of Operation	114					Operating hours/day:15 hours, from 5 pm to 7 am Friday: 24 hours. Operating hours/week: 114 hours
						No SOP to operate the turbine, the operator has been trained by TSU
Avg Output / Month (kwh)	5,954					There is no operation manual from the supplier
Avg Consumption / Month / Household (kwh	67					no record on KWh generated and kWh distributed
Population of Community						
Number of Households in Community	89					
Number of Household Customers	89					These customers include the public facilities, such as church which is free of charge
Number of households planned to be connec	86					
Number of Staff	5					
Commissioning Date	10-Mar-11					
MDST Date	Jan-12					
Construction Start Date						
FS Date	September 2009					
ECONOMIC						
Avg Kerosene Consumption Litre / Month	20					
Kerosene Cost Rp/Litre	7,000					
Households with Generator	-					
Avg petrol consumption Litre / Month (genset)						
Petrol Cost Rp/Litre						
Average electricity bill/month (Rp)	5,944					
Average Kerosene Saving / Month	134,056					
Average Petrol Cost Saving / Month	0					
Total Fuel Cost Saving / Month	11,930,960					
Average annual income/household, Rp.	5,000,000	Most of the people are cultivating cacao, coffee				
Historic Power Consumption (Rp. per HH)	12,000					
Other Benefit	Foto copy service, higher fee charged: 20,000/month					
Distance to the nearest grid	7 km					
MCB	2 Ampere					

Name of the village: Salutambun Barat, Kecamatan Buntu Malangka
Installed capacity: 30 kW

FINANCIAL	**Number**	**% Total**	**Rp.**	**Total**			**Remarks**
Capital Cost							
Total Capital Cost			576,001,000	576,001,000			TPK: IDR 16,771,000 (approx 3%) TPK:11,180,000 (approx. 2%)
Grant (Civil, M&E, Transmission Line, UPK, TPK)		96.3%	554,618,000	554,618,000			
Grant (Catchment area protection)		0.8%	4,383,000	4,383,000			
In-Kind Contribution - Assumed Balance		3.0%	17,000,000	17,000,000			
	Number (average/month)	**% Net Revenue**	**Rp.**	**Monthly Total (estimated)**	**Average 2011 (monthly)**	**Estimated 2012 (or annual) (based on data January to June)**	
Operating Costs							
Estimated Monthly O&M Costs (taken from the monthly reserve fund)		14%		145,500			
Monthly Staff Costs							
Manager	1	8%	87,477	87,477			
Secretary	1	8%	87,477	87,477			
Finance (*bendahara*)	1	8%	87,477	87,477			
Representative of sub-villages (bill collector for each sub village, from 7 sub-villages)	7	10%	104,972	104,972			
Operator II	1	15%	157,458	157,458			
Operator II	1	15%	157,458	157,458			
Total	12	65%	682,319	682,319			
			-	-		-	
Total Monthly Operating Costs				827,819	138,724	9,933,833	
	No. of Customer (Average)						
Tariff							
Special tariff for the poor (Class IV)	1		2500	2,500			
Tariff for lighting only (Class III)	47		5000	233,333			
Tariff for lighting and TV 14 inch (Class II)	42		10000	415,556			
Tariff for lighting and TV 21 inch (Class I)	19		15000	290,000			
Class I + additional 5000	2		20000	30,000			6600
Special tariff for higher utilisation of electronic equipment, with MCB 2 Ampere	1		60000	78,333			
	111						
Total Monthly Revenue				1,049,722	1,000,833	12,596,667	
One-Off Connection Fee			550,000	-			
Monthly Reserve Fund Contribution (net, after deducted by estimated O&M cost)		21%		221,903		2,662,833	
OPERATIONAL							
Capacity (kw)	30.0						
Planned installed capacity	16.1						
Output (kwh) to Date	125,202						the MDST was in October 2011. Approximate operating hours to date (as of 14 July 2012): 5690.99 hour, based on control panel information.
Implied Capacity Factor	50.4%						The installed capacity is 30 kW, and the estimated design based on available flow is 29.2 kW, average peak wattage is 22 kW (based on information from operator, without record)
Months of Operation	11.5						There is no kWh meter, only amperemeter and voltmeter, no regular record of kWh generated and consumed 110
Weekly Hours of Operation	114						Operating hours/day:15 hours, from 4 pm to 7 am Sunday: 20 hours. Operating hours/week: 110 hours
Avg Output / Month (kwh)	10,887						There is one page SOP attached in the powerhouse providing guide/instruction to operate the turbine, the operator has been trained by TSU
Avg Consumption / Month / Household (kwh)	98						There is no operation manual from the supplier no record on KWh generated and kWh distributed
Population of Community							
Number of Households in Community	117						
Number of Household Customers	111						These customers excludes the public facilities, such as church which is free of charge
Number of households planned to be connec	117						
Number of Staff	12						
Commissioning Date	15-Aug-11						
MDST Date	1 October 2011						
Construction Start Date							
FS Date							
ECONOMIC			5				
Avg Kerosene Consumption Litre / Month	16						
Kerosene Cost Rp/Litre	8,000						
Households with Generator	5						
Avg petrol consumption Litre / Month (genset)	10						
Petrol Cost Rp/Litre	7,000						
Average electricity bill/month (Rp)	9,433						
Average Kerosene Saving / Month	118,567						
Average Petrol Cost Saving / Month	60,567						1 petrol genset serving 3 HH. 5 genset serving 15 HH
Total Fuel Cost Saving / Month	12,396,632						
Average annual income/household, Rp.	6,000,000	Most of the people are cultivating cacao, coffee, paddy, and farming: swine, cow, buffalo					
Historic Power Consumption (Rp. per HH)	140,000						
Other Benefit	Chicken farming using lamps, nightitme						
Distance to the nearest grid	15.6 km						
MCB	1 Ampere		109 customers				
	2 Ampere		2 customers				

Name of the village: Orabua Selatan, kecamatan Sesena Padang
Installed capacity: 15 kW

FINANCIAL	**Number**	**% Total**	**Rp.**	**Total**		**Remarks**	
Capital Cost							
Total Capital Cost			351,868,000	351,868,000		TPK: IDR 10,466,000 (3%) TPK: 6,964,000 (2%)	
Grant (Civil, M&E, Transmission Line, UPK, TPK)		96.8%	340,541,000	340,541,000			
Grant (Catchment area protection)		2.2%	7,647,000	7,647,000			
In-Kind Contribution - Assumed Balance		1.0%	3,680,000	3,680,000			
Operating Costs	**Number (average/month)**	**% Net Revenue**	**Rp.**	**Monthly Total (estimated)**	**Estimated 2012 (based on data january to May)**		
Estimated Monthly O&M Costs (taken from the monthly reserve fund)		16%	200,500	200,500			
Monthly Staff Costs							
Manager	1	8%	105,000	105,000			
Secretary	1	8%	105,000	105,000			
Finance (*bendahara*)	1	8%	105,000	105,000			
Operator II	1	17.5%	220,500	220,500			
Operator II	1	17.5%	220,500	220,500			
Total	5	60%	756,000	756,000			
		0%	-	-	-		
Total Monthly Operating Costs				956,500	11,478,000		
Tariff	**No. of Customer (Average)**						
Basic Tariff/Tariff class III (only lighting)	20		10,000	204,000		The number of customer for each tariff is well recorded for each month	
tariff class II (Lighting with radio, amplifier)	57		15,000	852,000		total customer as of July 2012; 321 households	
tariff class III (Lighting with TV)	10		20,000	204,000			
Total Monthly Revenue				1,260,000	15,120,000		66.73
							67 weeks
Monthly Reserve Fund Contribution (net, after deducted by estimated O&M cost)		24%		303,500			16.75
OPERATIONAL							
Capacity (kw)	15.0						
Planned installed capacity	14.1						
Output (kwh) to Date	27,522					the MDST was in November 2011. Approximate operating hours to date (as of 15 July 2012): 7206.81 hour, based on control panel information. The operational capacity is 50 kW	
Implied Capacity Factor	13.8%					The village have record on kWh hour generated and kWh delivered	
Months of Operation	18.5						
Weekly Hours of Operation	108					Operating hours/day:14 hours, from 5 pm to 7 am Sunday: 24 hours. Operating hours/week: 108 hours	
Avg Output / Month (kwh)	1,488						
Avg Consumption / Month / Household (kwh)	14						
Population of Community							
Number of Households in Community	120						
Number of Household Customers	103					These customers include the public facilities, such as church which is free of charge	
Number of households planned to be connected	158						
Number of Staff	5						
Commissioning Date	1-Dec-10						
MDST Date	Nov-11						
Construction Start Date							
FS Date							
ECONOMIC							
Avg Kerosene Consumption Litre / Month	1						
Kerosene Cost Rp/Litre	15,000						
Households with Generator	-						
Avg petrol consumption Litre / Month (genset)							
Petrol Cost Rp/Litre							
Average electricity bill/month	12,233						
Average Kerosene Saving / Month	2,767						
Average Petrol Cost Saving / Month	0						
Total Fuel Cost Saving / Month	285,000				3,420,000		
Average annual income/household, Rp.	1,200,000	Most of the people are cultivating cacao, coffee, and paddy					
Historic Power Consumption (Rp. per HH)	40,000						
Other Benefit	none						
Distance to the nearest grid	10 km						
MCB	1 Ampere						

Name of the village: Bokin, Kecamatan Rantebua
Installed capacity: 6 kW

FINANCIAL	**Number**	**% Total**	**Rp.**	**Total**		**Remarks**
Capital Cost						
Total Capital Cost			504,545,000	504,545,000		TPK:3%) UPK: 2%
Grant (Civil, M&E, Transmission Line, UPK, TPK)		96.0%	484,375,000	484,375,000		
Grant (Catchment area protection)		1.6%	8,120,000	8,120,000		
In-Kind Contribution - Assumed Balance		2.4%	12,050,000	12,050,000		
	Number (average/month)	**% Net Revenue**	**Rp.**	**Monthly Total (estimated)**	**2012 (or annual) (based on data January to June)**	
Operating Costs						
Estimated Monthly O&M Costs (taken from the monthly reserve fund)		4%		50,000		This is to purchase lubricants only, based on village records
Monthly Staff Costs						
Manager	1	9%	100,000	100,000		Fixed cost, not based on percentage of revenue
Secretary	1	9%	100,000	100,000		Fixed cost, not based on percentage of revenue
Finance (*bendahara*)	1	9%	100,000	100,000		Fixed cost, not based on percentage of revenue
Operator I	1	22%	250,000	250,000		
Operator II	1	22%	250,000	250,000		
Total	5	71%	800,000	800,000		
				-	-	
Total Monthly Operating Costs				850,000	10,200,000	
Tariff	**No. of Customer (Average)**					
Special tariff for the poor (Class IV)	2		0	-		The special tariff for the poor is free of charge
Tariff for lighting only (Class III)	18		20000	360,000		
Tariff for lighting and radio (Class II)	3		25000	75,000		
Tariff for lighting and TV (Class I)	23		30000	690,000		
			5000			6600
Special tariff for higher utilisation of electronic equipment, with MCB 2 Ampere	0					
Total	46					
Total Monthly Revenue				1,125,000	13,500,000	
Monthly Reserve Fund Contribution (net, after deducted by estimated O&M cost)		24%		275,000	3,300,000	
OPERATIONAL						
Capacity (kw)	6.0					
Planned installed capacity	5.5					
Output (kwh) to Date	16,986					the MDST was in March 2012. The records of fee and revenue is only estimated in a monthly basis, there is not yet a regular revenue records and accounts.
Implied Capacity Factor	52.4%					The installed capacity is 6 kW,
Months of Operation	7.5					There is kWh meter connected for each phase (3 kWh meter) no regular record of kWh generated and consumed
						114
Weekly Hours of Operation	114					Operating hours/day:15 hours, from5 pm to 8 am Sunday: 24 hours. Operating hours/week: 114 hours
Avg Output / Month (kwh)	2,265					There is no operation manual from the supplier
Avg Consumption / Month / Household (kwh)	49					no record on KWh generated and kWh distributed
						There has been failure of operation, 3 times after it was handed over
Population of Community						
Number of Households in Community	110					
Number of Household Customers	46					These customers excludes the public facilities, such as church which is free of charge
Number of households planned to be connect	100					
Number of Staff	5					
Commissioning Date	1-Dec-11					
MDST Date	Mar-12					
Construction Start Date						
FS Date	31 October 2009					
ECONOMIC						
Avg Kerosene Consumption Litre / Month	5					
Kerosene Cost Rp/Litre	10,000					
Households with Generator	7					
Avg petrol consumption Litre / Month (genset)	90					
Petrol Cost Rp/Litre	10,000					
Average electricity bill/month (Rp)	24,457					
Average Kerosene Saving / Month	25,543					
Average Petrol Cost Saving / Month	875,543					
Total Fuel Cost Saving / Month	6,767,391					
Average annual income/household, Rp.	5,700,000	Most of the people are cultivating cacao, coffee, paddy, and farming: swine, cow, buffalo				
Historic Power Consumption (Rp. per HH)	-					
Other Benefit	Chicken farming, potential income Rp. 70,000/chicken (to be sold)					
Distance to the nearest grid	2 km	The new PLN grid just enter Rantebua Sub-district in the beginning of 2012				
MCB	1 Ampere	46 customers				

Name of the village: Bokin, Kecamatan Rantebua
Installed capacity: 6 kW

FINANCIAL	**Number**	**% Total**	**Rp.**	**Total**		**Remarks**
Capital Cost						
Total Capital Cost			428,190,000	428,190,000		TPK:3%) UPK: 2%
Grant (Civil, M&E, Transmission Line, UPK, TPK)			410,420,000	410,420,000		
Grant (Catchment area protection)		1.8%	7,570,000	7,570,000		
In-Kind Contribution - Assumed Balance		2%	10,200,000	10,200,000		
	Number (average/month)	**% Net Revenue**	**Rp.**	**Monthly Total (estimated)**	**2012 (or annual) (based on data January to June)**	
Operating Costs						
Estimated Monthly O&M Costs (taken from the monthly reserve fund)				50,000		No records on the operation and maintenance., except for the replacement of the generator set, since it is handed over no tariff has been applied
Estimated cost of repairing the genset			9,000,000			
						The generator was completely damaged 4 months after the MHP was handed over, the community has just purchased new generator
Monthly Staff Costs						
Manager	0					
Secretary	0					
Finance (*bendahara*)	0					
Operator I	1					
Operator II	0					
Total	1					
				-	-	
Total Monthly Operating Costs				-	-	
Tariff	**No. of Customer (Average)**					
Note: There is no tariff yet since the village has not yet agreed on what tariff to be applied.						The special tariff for the poor is free of charge
Total number of HH connected	63			0 -		
				0 -		
				0 -		
						6,600
Special tariff for higher utilisation of electronic equipment, with MCB 2 Ampere	63					
Total Monthly Revenue				-	-	
Monthly Reserve Fund Contribution (net, after deducted by estimated O&M cost)						This reserve fund is based on voluntary contribution of the village. 4 month after comissioning, the genetator was damaged due to overload. Thus the villagers voluntarliy contribute to purchase new generator. Rp. 9000000 is the balance in their funds after purchasing new generator
OPERATIONAL						
Capacity (kw)	10.0					
Planned installed capacity	4.3					
Output (kwh) to Date	3,187					the MDST was in March 2012. The records of fee and revenue is only estimated in a monthly basis, there is not yet a regular revenue records and accounts. This is due the failure of the generator, and the operation needs to start from the beginning.
						108
Implied Capacity Factor	5.9%					The installed capacity is 10 kW, but the preliminary design capacity is 4.5 kW
Months of Operation	7.5					
Weekly Hours of Operation	108					Operating hours/day:14 hours, from 5 pm to 7 am Sunday: 24 hours. Operating hours/week: 108 hours
Avg Output / Month (kwh)	425					
Avg Consumption / Month / Household (kwh	7					There is no operation manual from the supplier no record on KWh generated and kWh distributed
						Since PLN entering the sub-district Rantebua, to allow PLN electrify Buangin, there is a minimum number of customers that PLN Required: 200 Households
Population of Community						
Number of Households in Community	99					
Number of Household Customers	63					
Number of households planned to be connec	98					
Number of Staff	1					
Commissioning Date	1-Dec-12					
MDST Date	Mar-12					
Construction Start Date						
FS Date	31 October 2009					
ECONOMIC						
Avg Kerosene Consumption Litre / Month	20					
Kerosene Cost Rp/Litre	10,000					
Households with Generator	15					
Avg Petrol Consumption Litre / Month (genset)	120					
Petrol Cost Rp/Litre	10,000					
Average electricity bill/month (Rp)	0					
						People in this village seems to have more energy requirement than other villages. Most of the households have television and radio set, and few of them have rice cooker, even washing machine
Average Kerosene Saving / Month	200,000					
Average Petrol Cost Saving / Month	1,200,000					
						Most of the people are cultivating cacao, coffee, paddy, and farming: swine, cow, buffalo, but they also receive supports from their relatives who work overseas or in national big cities
Total Fuel Cost Saving / Month	21,600,000					
Average annual income/household, Rp.	4,750,000					
Historic Power Consumption (Rp. per HH)	56,000					
Other Benefit	Sewing,					
Distance to the nearest grid	2.5 km		The new PLN grid just enter Rantebua Sub-district in the beginning of 2012			
MCB	1 Ampere		63 customers			

Name of the village: Kare Penanian
Installed capacity: 12 kW

FINANCIAL	**Number**	**% Total**	**Rp.**	**Total**		**Remarks**
Capital Cost						
Total Capital Cost			581,292,000	581,292,000		TPK: IDR 11,528,000 (2%) UPK:5,764,000 (1%)
Grant (Civil, M&E, Transmission Line, UPK, TPK)		91.8%	533,800,000	533,800,000		
Grant (Catchment area protection)		7.3%	42,592,000	42,592,000		
In-Kind Contribution - Assumed Balance		0.8%	4,900,000	4,900,000		
	Percentage (%)	**% Net Revenue**	**Rp.**	**Monthly Total (estimated)**	**Estimated 2012 (or annual)**	
Operating Costs						
Estimated Monthly O&M Costs (taken from the monthly reserve fund)		17%		50,000		Lubricants only
Monthly Staff Costs						
Manager	1	3%	10,000	10,000		
Secretary	1	3%	10,000	10,000		
Finance (*bendahara*)	1	3%	10,000	10,000		
Operator I	1	10%	30,000	30,000		
Operator II	1	10%	30,000	30,000		
Total	5	30%	90,000	90,000		
			-	-	-	
Total Monthly Operating Costs				140,000	1,680,000	
Tariff	**No. of Customer (Average)**					
						There is a private MHP of *Yayasan Walda,* Tariff is Rp. 20,000/customer. The MHP LMP is only charged 15,000 since the villagers feels Rp. 40,000/month is too costly. The customer receving electricity from LMP also receives
Single tariff	20		15000	300,000		electricity from MHP of *Yayasan Walda*
	20					
Total Monthly Revenue				300,000	3,600,000	
Monthly Reserve Fund Contribution (net, after deducted by estimated O&M cost)		53%		160,000	1,920,000	
OPERATIONAL						
Capacity (kw)	12.0					
Planned installed capacity	5.2					
						the MDST was in June 2012. Approximate operating hours to date (as of 17 July 2012): is not recorded due to
Output (kwh) to Date	2,912					failure in the control panel. The hourmeter is not working properly.
Implied Capacity Factor	9.6%					
						There is no kWh meter, only amperemeter and voltmeter, no regular record of kWh generated and
Months of Operation	3.5					consumed
						Operating hours/day:10 hours, from 7 am to 5 pm, the night service is provided by the MHP from yayasan
Weekly Hours of Operation	40					Walda. Operating hours/week: 40 hours
						According to FS, the preliminary estimated capacity is 5.2 kW
Avg Output / Month (kwh)	832					There is no operation manual from the supplier
Avg Consumption / Month / Household (kwh)	42					no record on KWh generated and kWh distributed
						The fuse was damaged, the control panel does not work
						There are 6 households using washing machine, and 12
Population of Community						households have refrigerator
Number of Households in Community	120					
Number of Household Customers	20					
Number of households planned to be connectec	120					
Number of Staff	5					
Commissioning Date	1-Apr-12					
MDST Date	Jun-12					
Construction Start Date						
FS Date						
ECONOMIC						
Avg Kerosene Consumption Litre / Month	15					
Kerosene Cost Rp/Litre	3,000					
Households with Generator	5					
Avg Petrol Consumption Litre / Month (genset)	120					
Petrol Cost Rp/Litre	6,000					
Average electricity bill/month (Rp)	15,000					
Average Kerosene Saving / Month	30,000					
Average Petrol Cost Saving / Month	705,000					
Total Fuel Cost Saving / Month	3,675,000					1 genset serves 3 HH
Average annual income/household, Rp.	5,000,000	Most of the people are cultivating cacao, coffee, paddy, and farming: swine, cow, buffalo				
Historic Power Consumption (Rp. per HH)	30,000					
Other Benefit	electricity for carpentry, but is has not yet so far utilized for carpentry (potential economid benefit)					
						energy service from photovoltaic is free of charge. There are 32 HH served with electricity from the Solar PV. Tariff of Private MHP is Rp. 20,000/HH/month, 145 HH are
Other alterantive energy	private MHP (tariff: 20,000/household), Solar Photovoltaic					served with this private MHP (all HHs in the village are
Distance to the nearest grid	15 km					
MCB	2 Ampere		20 customers			(still in planning, has not yet been installed)

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MAROS DISTRICT - TIMPUSENG VILLAGE

FINANCIAL	**Number**	**% Total**	**Rp.**	**Total**	
Capital Cost (from Fact Sheet)					
Total Capital Cost			363,000,000	363,000,000	
Grant (Civil, M&E, Transmission Line, UPK, TPK)		90%	328,000,000	328,000,000	
Grant (Catchment area protection)		0%	-	-	
Equity (cash contribution from the village)		7%	25,000,000	25,000,000	
In-Kind Contribution		3%	10,000,000	10,000,000	
Operating Costs	**Number**	**% Net Revenue**	**Rp.**	**Monthly Total**	**2012**
Monthly O&M Costs (Assmpn)		3%	50,000	50,000	600,000
Monthly Staff Costs (Assmpn)					
Manager	1	6%	100,000	100,000	
Operator	2	39%	300,000	600,000	
Finance	1	6%	100,000	100,000	
Secretary	1	6%	100,000	100,000	
Total	5	58%		900,000	10,800,000
Total Monthly Operating Costs		61%		950,000	11,400,000
Tariff					-
One-Off Connection Fee	10		550,000	5,500,000	
Number New Connections / Month (Assmpn)	-		550,000	-	
Basic Tariff	38		15,000	570,000	
Tariff Incremement	28		35,000	980,000	
Total Monthly Revenue				1,550,000	18,600,000
Monthly Reserve Fund Contribution		50%		600,000	7,200,000

OPERATIONAL	
Capacity (kW)	20
Average output (kW)	18
Planned installed capacity	20
Output to date	n/a
Month of operation	26.5
Weekly Hours of Operation	118
Avg Output / Month (kwh)	8,496
Implied Capacity Factor	58%
Avg Consumption / Month / Household (kwh)	129
Population of Community	
Number of Households in Community	86
Number of Household Customers	66
Number of households planned to be connected	86
Number of Staff	5
Commissioning Date	
MDST Date	24 April 2010
Construction Start Date	
FS Date	

ECONOMIC		
Avg Kerosene Consumption Litre / Month	15	
Kersone Cost Rp/Litre	10,000	
Households with Diesel Generator	-	
Avg Diesel Consumption Litre / Month	-	
Diesel Cost Rp/Litre	N/A	
Average Kerosene Fuel Cost Saving / Month	121,667	Assuming just a single connection for those presently without a connection
Average Diesel Fuel Cost Saving / Month		
Total Fuel Cost Saving / Month	8,030,000	
Historic Power Consumption (Rp. per HH)		
Other Benefit		
Distance to nearest grid	3	km
MCB	1	Ampere

HOUSEHOLD SURVEY	**K Litres/Mth**	**K Rp.**	**K Total**	**D Litres/Mth**	**D Rp.**	**D Total**	**Elect Bill/Mth**	**+ / -**	**PLN Bill/Mth**
Household 1 (Farmer)	20	10,000	200,000	-	-	-	35,000	165,000	40,000
Household 2 (Farmer)	15	10,000	150,000	-	-	-	35,000	115,000	
Household 3 (Farmer)	10	10,000	100,000				15,000	85,000	
Household 4 (Farmer)									
Household 5 (Farmer)									
AVG	15		150,000	-		-	28,333		
Kerosene Avg Saving			121,667						
Diesel Avg Saving									

MAROS DISTRICT - BARUGAE VILLAGE

FINANCIAL	**Number**	**% Total**	**Rp.**	**Total**	
Capital Cost (from Fact Sheet)					
Total Capital Cost			545,000,000	545,000,000	
Grant (Civil, M&E, Transmission Line, UPK, TPK)		72%	395,000,000	395,000,000	
Grant (Catchment area protection)		0%	-		
Equity		28%	150,000,000	150,000,000	
In-Kind Contribution		0%		-	
Operating Costs	**Number**	**% Net Revenue**	**Rp.**	**Monthly Total**	**2012**
Monthly O&M Costs (Assmpn)		13%	215,000	215,000	2,580,000
Monthly Staff Costs (Assmpn)					
Manager	1	4%	75,000	75,000	
Operator	3	26%	150,000	450,000	
Finance	1	4%	75,000	75,000	
Secretary	1	4%	75,000	75,000	
Bill Collector	2	12%	100,000	200,000	
Total	8	100%		675,000	8,100,000
Total Monthly Operating Costs		165%		890,000	10,680,000
Tariff					-
One-Off Connection Fee	10		550,000	5,500,000	
Number New Connections / Month (Assmpn)	-		550,000	-	
Basic Tariff (per MCBU)	59		20,000	1,180,000	
Tariff Incremement (per MCBU)	18		30,000	540,000	
Total Monthly Revenue				1,720,000	20,640,000
Monthly Reserve Fund Contribution		50%		830,000	9,960,000
OPERATIONAL					
Capacity (kW)	20				
Average Output (kW)	19				
Planned installed capacity	20				
Output to date	n/a				
Month of Operation	16				
Weekly Hours of Operation	118				
Avg Output / Month (kwh)	8,968				107,616
Implied Capacity Factor	65%				
Avg Consumption / Month / Household (kwh)	116				1,398
Population of Community					
Number of Households in Community	260				
Number of Household Customers	77				
Number of households planned to be connecte	78				
Number of Staff	8				
Commissioning Date					
MDST Date	March 2011				
Construction Start Date					
FS Date					
ECONOMIC					
Avg Kerosene Consumption Litre / Month	20				
Kersone Cost Rp/Litre	10,000				
Households with Diesel Generator	-				
Avg Diesel Consumption Litre / Month	-				
Diesel Cost Rp/Litre	n/a				
Average Kerosene Fuel Cost Saving / Month	90,000	Assuming justa single connection for those presently without a connection			
Average Diesel Fuel Cost Saving / Month					
Total Fuel Cost Saving / Month	6,930,000				
Historic Power Consumption (Rp. per HH)					
Other Benefit					
Distance to nearest grid	3	km			
MCB	1	ampere			

HOUSEHOLD SURVEY	**K Litres/Mth**	**K Rp.**	**K Total**	**D Litres/Mth**	**D Rp.**	**D Total**	**ect Bill/M**	**+ / -**	**LN Bill/Mth**
Household 1 (Farmer)	15	10,000	150,000	-	-	-	30,000	120,000	40,000
Household 2 (Farmer)	10	10,000	100,000	-	-	-	30,000	70,000	
Household 3 (Farmer)	10	10,000	100,000				20,000	80,000	
Household 4 (Farmer)									
Household 5 (Farmer)									
AVG	12		116,667	-		-	26,667		
Kerosene Avg Saving			90,000						
Diesel Avg Saving									

Name of the village: Saluburonan
Installed capacity: 30 kW

FINANCIAL	**Number**	**% Total**	**Rp.**	**Total**			**Remarks**
Capital Cost							
Total Capital Cost			178,860,500	178,860,500			TPK: IDR 5,331,300(3%) UPK:3,554,200 (2%)
Grant (Civil, M&E, Transmission Line, UPK, TPK)		99.4%	177,710,500	177,710,500			
Grant (Catchment area protection)		0.0%	-				
In-Kind Contribution - Assumed Balance		0.6%	1,150,000	1,150,000			
	Percentage (%)	**% Net Revenue**	**Rp.**	**Monthly Total (estimated)**	**2011**	**Estimated 2012 (or annual)**	
Operating Costs							
Estimated Monthly O&M Costs (taken from the monthly reserve fund)	11%			100,000			estimated O&M cost to purchase lubricants, maintaining the power house, etc
Monthly Staff Costs							
Manager	1	fixed fee	100,000	100,000			
Secretary	1	fixed fee	50,000	50,000			
Finance (*bendahara*)	1	fixed fee	50,000	50,000			
Operator I	1	fixed fee	200,000	200,000			
Operator II	1	fixed fee	200,000	200,000			
Total	5	0%	600,000	600,000			
			-	-		-	
Total Monthly Operating Costs				700,000		8,400,000	
	No. of Customer (Average)						
Tariff							
Class I (maks 60 watt, 3 lamps)	41		10000	410,000			112
Class II (125 Watt, with 1 electronic equipmer	26		15000	382,500			
Class III (150 watt, 2 electronic equipment)	4		20000	86,667			
additional (extra, penalty, etc)			5000	19,333			
	71						
Total Monthly Revenue				898,500	11,510,000	10,782,000	
Monthly Reserve Fund Contribution (net, after deducted by estimated O&M cost)		22%		198,500		2,382,000	
OPERATIONAL							
Capacity (kw)	30.0						
Planned installed capacity	30.0						
Output (kwh) to Date	220416						the MDST was in November 2010. Approximate operating hours to date (as of 17 July 2012):is not recorded since there is no hourmeter, only voltmeter and amperemeter
Implied Capacity Factor	49.8%						
Months of Operation	20.5						There is no kWh meter, only amperemeter and voltmeter, no regular record of kWh generated and consumed
Weekly Hours of Operation	112						Operating hours/day:16 hours/day, 112 hours/week
							According to Saluburonan proposal, the preliminary estimated capacity is 24 kW
Avg Output / Month (kwh)	10,752						There is no operation manual from the supplier, but the operators were trained by TSU
Avg Consumption / Month / Household (kwh)	152						no record on KWh generated and kWh distributed
Population of Community							
Number of Households in Community	200						based on the information of the village regulation
Number of Household Customers	71						
Number of households planned to be connect	200						
Number of Staff	5						
Commissioning Date							
MDST Date	Nov-10						
Construction Start Date							
FS Date							
ECONOMIC							
Avg Kerosene Consumption Litre / Month	30						
Kerosene Cost Rp/Litre	10,000						
Households with Generator	-						
Avg Petrol Consumption Litre / Month (genset)	120						
Petrol Cost Rp/Litre	6,000						
Average electricity bill/month (Rp)	12,685						
Average Kerosene Saving / Month	287,315						
Average Petrol Cost Saving / Month	0						
Total Fuel Cost Saving / Month	20,351,500						
Average annual income/household, Rp.	4,500,000	Most of the people are cultivating cacao, coffee, paddy,					
Historic Power Consumption (Rp. per HH)							
Other Benefit	electricity for carpentry, but is has not yet so far utilized for carpentry (potential economid benefit)						
other alterantive energy	private MHP, Solar Photovoltaic						
Distance to the nearest grid	4	km	already 5 Households decided not to use MHP but subscribed to MHP				
MCB	2	Ampere					

Name of the village: Leppan, kecamatan Malimbang Balepe
Installed capacity: 30 kW

FINANCIAL	**Number**	**% Total**	**Rp.**	**Total**			**Remarks**
Capital Cost							
Total Capital Cost			284,485,000	284,485,000			TPK: IDR 8,505,900 (3%) UPK:6,670,600 (2%)
Grant (Civil, M&E, Transmission Line, UPK, TPK)		94.7%	269,355,000	269,355,000			
Grant (Catchment area protection)		0.0%	-	-			
In-Kind Contribution - Assumed Balance		5.3%	15,130,000	15,130,000			
Operating Costs		**% Net Revenue**	**Rp.**	**Monthly Total (estimated)**	**2011**	**Estimated 2012 (or annual)**	
Estimated Monthly O&M Costs (taken from the monthly reserve fund)	9%			150,000			estimated O&M cost to purchase lubricants, maintaining the power house, transport to purchase lubricants
Monthly Staff Costs							
Manager	1	fixed fee	100,000	100,000			
Secretary	1	fixed fee	100,000	100,000			
Finance (*bendahara*)	1	fixed fee	100,000	100,000			
Operator I	1	fixed fee	300,000	300,000			
Operator II	1	fixed fee	300,000	300,000			
Total	5	0%	900,000	900,000			
Estimated cost of repairing the dynamo			*4,864,000*				
car rent for bringing the equipment, checking the dynamo, bringing the technician			1,340,000				Data in 2011 is not completed, because the coil of the generator was damaged, and the generator was not in operation for 6 month, since October 2011
repairing civil works : cements,			146,000				
Repairing dynamo			678,000				
Labour fee			2,700,000				
Total Monthly Operating Costs				1,050,000		12,600,000	
Tariff	**No. of Customer (Average)**						
Single tariff during the year of 2011	168		10,000	1,680,000	16,800,000		
Single tariff, from month 2 to month 4 2012	168		5,000	410,000		1,230,000	112
Single tariff from month 5 to month 12 2012	168		10,000	1,680,000		13,440,000	
	336						
Total Monthly Revenue				1,680,000		14,670,000	
Monthly Reserve Fund Contribution (net, after deducted by estimated O&M cost)		38%		630,000		7,560,000	
OPERATIONAL							
Capacity (kw)	30.0						
Planned installed capacity	30.0						
estimated Output (kwh) after the dynamo was repaired	55,176.0						
estimated Output (kwh) before the dynamo was repaired (since the operation started in Dec 2010)	90,288.0						the MDST was in December 2010. Approximate operating hours to date (as of 18 July 2012): is not recorded due to failure in the control panel. The ampere meter was damaged and full of insects. The fuse is damaged
Implied Capacity Factor (after the dynamo was repaired)	46%						estimated peak power: 22 kW
Implied Capacity Factor (after the dynamo was repaired)	46%						
Months of Operation (after the dynamo was repaired)	5.5						No regular record of kWh generated and consumed
Months of Operation (before the dynamo was repaired)	9.0						
Weekly Hours of Operation	114						Operating hours/day:15 hours/day, 114 hours/week
Avg Output / Month (kwh)	10,032						There is no operation manual from the supplier, but the operators were trained by TSU
Avg Consumption / Month / Household (kwh)	60						no record on KWh generated and kWh distributed
Population of Community	357						The fuse was damaged, the control panel does not work
Number of Households in Community							based on the information of the village regulation
Number of Household Customers	168						The month of operation recorded is estimated since it is under operation again
Number of households planned to be connecte	281						
Number of Staff	5						
Commissioning Date							
MDST Date	Dec-10						
Construction Start Date							
FS Date							
ECONOMIC							
Avg Kerosene Consumption Litre / Month/hous	5						
Kerosene Cost Rp/Litre	9,000						
Households with Generator	-						
Avg Petrol Consumption Litre / Month (genset)	120						
Petrol Cost Rp/Litre	6,000						
Average electricity bill/month (Rp)	10,000						
Average Kerosene Saving / Month	35,000						
Average Petrol Cost Saving / Month	0						
Total Fuel Cost Saving / Month	5,880,000						
Average annual income/household, Rp.	2,000,000	Most of the people are cultivating coffee, paddy is only for self consumption					
Historic Power Consumption (Rp. per HH)							
Other Benefit	None						
Other alterantive energy							
Distance to the nearest grid	11	km	The closest distance to PLN grid is to Malimbang				
MCB	1	Ampere					

APPENDIX E: APPROACH METHODOLOGY

Detailed approach/methodology is given below:

A. Project Mobilization and Data Gathering

Meetings prior to field visits: Several meetings were conducted at the initial phase of the study to (i) present the approach of the study to the PNPM Support facility (ii) determine number of sites to be visited and develop selection criteria for site selection and (iii) select sites to be visited**.** The consultant conducted the initial meeting with PNPM Support Facility (PSF) team on the 25th of May 2012 to present the methodology/approach in conducting the study on the Return of Investment/Cost-effectiveness of MHP. Following the initial meeting, we met with TSU representatives to obtain preliminary information on TSU sites and also visited the NMC office for clarification on PNPM Green MHP sites, particularly on those that have been commissioned and handed over to the community (*Musyawarah Desa Serah Terima/MDST*).

During discussion with PSF in the initial meeting, it was agreed that the consultant will establish site selection criteria based on the information and data available at PNPM, TSU and NMC offices in Jakarta; and discussions with PNPM, TSU and NMC team. The selection criteria have to consider the sites most representing MHP sites developed under PNPM Green and the number of sites to be visited.

As the focus of the study is PNPM Green MHP sites, the evaluation on other possible rural electrification alternatives is only conducted for the selected sites. The aim is to see whether there are other possible electricity sources alternatives besides MHP, such as grid or solar energy (subject to data availability of these alternative sources of the selected sites). It was indicated that most likely the consultant would compare MHP with electricity sourced from the nearest grid.

Site selection: We developed a set of criteria for consideration in selecting the sites representing PNPM Green that would serve the objective of the study:

1. *MHP that has reached MDST status*: in Green PNPM, MHPs are handed over to the village community after the MHP is commissioned, and operational testing is successfully conducted. This is to ensure that the project runs well when it is operated by the community. The hand-over of the project is defined as *Musyawarah Desa Serah Terima (MDST). Sites* selected for field visit are those that have reached MDST stage*.* The non-comissioned MHP sites or the most recent commissioned MHP sites that has not yet been handed over to the community will not have operational data (monthly revenue, actual data of household connected to MHP, actual performance data) required to perform return on investment/cost of effectiveness analysis.

2. *TSU assistance and Non TSU Assistance*: As Green PNPM sites cover those with and without assistance of TSU, the selected cover both types. The MHPs without TSU assistance reached MDST status are located in Maros district and Tanah Toraja District, South Sulawesi Province and in Lebong District, Bengkulu Province and Pasaman District, West Sumatera Province.

3. *Scale of scheme (as measured by cost / kw / number households)*: variation of scale of MHP scheme is another factor to be considered in selecting sites for field vist. The idea is that schemes may require some minimum scale to be effective. Based on the 41 sites that have reached MDST status, there are 21 sites with installed capacity of less than 10 kW, 12 sites with installed capacity between 11 kW to 20 kW, 7 sites with installed capacity between 21 kW to 30 kW and 1 site which is larger than 50 kW. With regards to number of households connected to MHPs reached MDST status, there are 23 sites with number of households less than or equal to 100, 11 sites between 101 to 200 households, 4 sites between 201 to 300 households, 1 site between 401 to 500 households, and 2 sites larger than 500 households.

4. *Scheme deemed to be working well / not working well*: Based on the information from the NMC and the summary table of MHP sites, the sample selection process would consider covering sites deemed to be performing well, not so well and poorly. This would allow identification of challenges that faced by those performing not so well and poorly, and the success factor of those that perform well.

5. *Remoteness of location (i.e. + / - X kilometres of an urban area) and geographical location* : sites selection process would consider to choose sites that are at varying distances from urban centres. Such centres may influence: i) economic potential of the community that, in turn, will impact upon the success of the MHP scheme; ii) presence of nearby alternative energy sources such as grid, iii) the social/cultural challenge in the operation of MHP. Thus the MHP selected covers both Sumatera and Sulawesi regions.

6. *Possible of other alternative energy sources such as and possibility of grid connection in the near future*: Although the eligibility of receiving block grant to develop MHP under Green PNPM is that the distance with the grid should be more than 2 km, there are some sites where PLN grid enters the village when the MHP has been developed. Thus the selected sites include few sites that has potential of possible alternative energy sources such as grid, or other sources (e.g., solar energy). Discussion with NMC indicated a couple of sites among those 41 sites where PLN grid just entered or would electrify the sites.

Considering time and resources constraint and to get a balance of detail analysis and the time spent for the site visit, 15 sites were selected for field visit. Prior to field visit, we coordinated with NMC to plan ahead and distribute the questionnaires to ensure that the facilitator onsite (ASTAL and FKL) could assist in arranging the meeting and handed the questionnaire to the respondents. We concluded the final selection of these 15 sites with the following rationale:

- The 15 selected sites are already reached MDST status, which means that the commissioning has been successful and MHP has been handed over to the village community.
- Considering larger number of sites with TSU assistance, among those that have reached MDST status, the selected sites are of a balanced proportion between those with TSU assistance (10 sites) and those without TSU assistance (5 sites).
- Among the 41 MDST sites, there are 4 in Sumatera and 37 located in Sulawesi. It was decided to select the 4 sites in Sumatera as these represent those with TSU (Aceh and West Sumatera) and without TSU site (Bengkulu)
- Among the 37 sites in Sulawesi, the selected sites are in Maros, Tana Toraja (without TSU) and in Toraja Utara and Mamasa (with TSU) as these are more reasonable

samples located in cluster. In terms of distance and time schedule, these villages are feasible and reasonable to reach.

There are sites located in these area recommended by NMC to be visited due to their characteristics in terms of contribution to the community and the social and economic impact and these are taken into account. Some of these are just reaching MDST within 1 to 3 months. Thus, the selected sites consist of those that have reached MDST for 6 months or more, and those that reached MDST status less than 6 months.

Exhibit 1.2 of the report provides a list of the selected sites for field visit with the design capacity and the actual number of household connected. Those highlighted in yellow are sites recommended by NMC to be visited. The data analysis is based on the condition and data taken during the site visit, particularly based on completed questionnaires, and data of feasibility study or project proposal of these sites.

Field Visits: The site visit schedule is given in Appendix A. During the site visit, we conducted a survey by interviewing certain respondents and visiting the sites to get the overview of the condition of the sites and the documented data that could only be obtained on-site such as MHP operational records. The number of people to be interviewed is minimum 8 (eight) people from each site, and the respondents expected to attend the interview sessions are given below. Most of these respondents were available for discussions during field visits:

1. Head of the village or the representative of the head of the village
2. The Operational and Maintenance team, minimum 2 people (including operator of MHP) (*Tim Pelaksana Pemelihara Prasarana*)
3. The construction team, minimum 2 people (*Tim Pengelola Kegiatan, TPK*)
4. Representative of Households (representative of 3 households)

To facilitate the interview, we have developed a questionnaire to be completed by the above respondents. The questions included are mixed of fixed-answered and open questions. These are related to financial information such as associated cost such as block grant, contribution from the village, other cost during construction and operation and maintenance cost and the revenues, operational information including questions related to environmental impact and possible energy displaced and alternative sources of energy, and socio-economic information related to the impact of MHP to the community such as the household income, impact to the household activities and income, and general feedback. Example of questionnaire is given in Appendix B.

Other sources of data: For comparative analysis purposes, some data is sourced from other studies and/or programs on MHP development and on alternative energy sources. For example, estimated cost/kW of the MHP developed under PNPM Green is compared with cost/kW of MHP of similar sizes of other studies and/or programs.

B. Data Analysis

Data analysis comprises of financial analysis, economic impact analysis and the evaluation on operation and management. Information on technical. socio-economic, commissioning data and site location of TSU-supported sites were obtained through sites visits as well as readily data available with TSU and NMC. For the selected sites without support from TSU, we liaised with NMC for required data gathering and questionnaire distribution.

Financial Analysis

In conducting the financial analysis, the actual costs and benefits associated with implementing the PNPM green MHP were evaluated based on the data gathered through contacts with TSU and NMC, and through field visits. In addition to the financial cost of MHP itself, cost of in-kind contributions of the technical cost component was considered in the analysis to the extent possible. the actual data regarding the block grant and the cost contribution from the community is available and was gathered during the field visit. The cost and benefit evaluation addresses both the absolute levels of costs / benefits witnessed and the relationship between the costs / benefit obtained and the size of the different MHP. Since the information on projected cost on MHP operation is not available in the feasibility study or project proposals of these MHP, the actual project cost could only be compared with similar data of other studies. The cost / benefit evaluation detailed individual cost / benefit components and form the basis of the financial and economic analysis.

Economic Impact Analysis

We developed economic models based on data on site location, socio-economic and cost data of the selected sites, as well as the data obtained during the site visit, particularly on the updated information on socio-economic profile of the villages (number of household, and energy cost spent per household) the tariff imposed to the community, number of household connected and actual operation and management cost to:

2. Calculate the net present value and the economic rate of return of the selected projects in order to identify the sustainability of the MHP for self-operation in the long-run. This is done based on information on the actual tariffs charged to users
3. Evaluate the economic impact of the electrification of the MHP to see the economic benefits that may accrue from non-existing electricity services on site or displacement of more expensive for of energy services depending on the condition prior to MHP installation. We took into consideration the energy consumption pattern prior to and post electrification in the sites based on information obtained from documentation of previous studies/evaluation activities as well as interview with households currently connected to MHP. This addresses household savings on fuel costs and the level of productive end use such as small business development, increase in productivity, etc., from the energy service provided by the selected MHP project.

In addition to quantitative analysis using models and financial indicators, qualitative assessment on the benefit received by the community through MHP operation was performed.

Operation and Management Quality Assessment

The assessment of project operation and management quality takes into account the actual performance of the MHP scheme, including the project's operational metrics and on-site management activities, in achieving the target results, but not comparing this actual performance with the key performance indicators (KPI) established for the program because the KPI was set for the overall program achievement.
Thus, in this study we reviewed selected MHP projects of the PNPM Green in relation to the actual operation and management performance delivered by the project. This covers the following output:

1. *Identification of actual technical performance of MHP compared with the design plan*:
    - Site selection: We evaluated whether the site is appropriately selected according to the objectives of the PNPM Green MHP scheme in improving living conditions with electrification, checked the numbers of beneficiaries in

the location and checked whether the communities have proposed and implemented catchment and conservation plans.

- Quality of design: whether MHP installations are designed to generate the maximum amount of electricity and evaluate the construction quality, quality of service provided (i.e. wattage per household connected, reliability of service, etc), tariff structure, and operational and maintenance (O+M) practices

2. *Identification of the project's level of environmental compliance with the prevailing regulations*: The range of the MHP's installed capacity under PNPM Green is between 2 kW to 78 kW (average of 15 kW) and this size falls below the UKL/UPL (environmental management effort/environmental monitoring effort) threshold for MHP type activity. As the pilot activities under PNPM Rural, MHP of PNPM Green project falls under B category which does not require RKL/RPL document (Environmental management plan/environment monitoring plan). We noted the main concern on environmental impact of these MHP which was remarked on the project proposals/feasibility studies.

Identification of the effectiveness and efficiency of the operation and management of the MHP: This is carried out by evaluating the institutional set-up in operation and management of the MHP, such as the credential of the operational and management team (*Tim Pelaksana Pemelihara Prasarana*, TP3 or *Unit Pelaksana Teknis, UPT*), the check on existing Standard Operation Procedure and the village regulation (peraturan desa) that regulates tariff, number of connection and eligibility for receiving electricity from the selected MHP projects.