PROPOSAL FOR REVIEW

Project Title:	**Indonesia: Renewable Energy Small Power (RESP) Project**
GEF Focal Area:	Climate Change
Country Eligibility:	Convention Ratified August 23, 1994
Total Project Costs:	US $ 168 million
GEF Financing:	US $ 6 million
Country Contribution:	US $ 62 million
Cofinancing/Parallel Financing:	IBRD US $ 100 million
GEF Implementing Agency:	World Bank
Executing Agency:	PLN (national power utility); Directorate of Private Power
Estimated Approval Date:	November 1996
Project Duration:	4 years
GEF Preparation Costs:	No GEF PDF
Government Endorsement:	Received 7 July, 1995

INDONESIA: Renewable Energy Small Power (RESP) Project

SECTORAL CONTEXT

1. Indonesia's basic goals and policies for the development of the energy sector are described in the Outlines of State Policy, March 1993. The policy highlights the importance of meeting Indonesia's rapidly growing energy needs in an efficient manner, including through conservation and diversification of primary energy resources, and minimizing the adverse environmental and social impacts of energy use. A key and continuing thrust of the Government's energy strategy is to slow down Indonesia's transition to net oil importer status by diversifying energy supply for domestic consumption towards alternative and economic indigenous resources that have a non-exportable surplus or are non-tradeable, such as renewable energy. In the power sub-sector, Indonesia recognizes that an adequate, reliable and reasonably priced electricity supply is essential for the country's continuing development. Rural electrification (RE) is a key and integral part of the Government's rural development strategy.

2. In Indonesia today, the cost of supplying electricity to rural households that have access to grid supply from the national power utility (PLN) is high. PLN owns and operates over 5,000 diesel plants scattered throughout Indonesia -- about 2,000 MW of diesel generating capacity -- as a primary means to supply power for rural electrification (RE). Apart from the high cost of sustaining diesel operations in remote areas, the cost is high because much of the diesel plant is under-utilized, with capacity factors averaging less than 30%. In addition, even in the case of the RE loads supplied by regional grids, diesel is the marginal fuel at most times of system operations.

3. Under the present policy of nationally uniform electricity tariffs, the total cost of PLN supply for many RE loads is well in excess of the tariffs to such consumers. PLN's "avoided costs" are estimated, on average, to be about Rp. 140/Kwh (about US ¢ 6.6/kWh) for the Java-Bali grid, about Rp. 196/kWh (US ¢ 9.3/kWh) for the seven regional grids outside Java, and as high as Rp. 250/kWh (US ¢ 11.7/kWh), for PLN's large number of diesel-based isolated units and mini-grids. In contrast, PLN's average revenue from the typical rural consumer is only Rp 137/kWh (US ¢ 6.45/kWh). Thus, diesel-based rural electrification implies a significant subsidy burden on PLN.

4. The Government attaches high priority to cost effective renewable-based energy supply as a means of ensuring high and environmentally sustainable rates of economic growth. Increased penetration of renewable based generation will have a significant and positive impact on the environment by reducing local pollutants such as SO_2 as well as pollutants of global concern such as emissions of green house gases (GHG). To the extent that this development displaces kerosene consumption and diesel generation, it reduces the negative environmental impacts of transport, waste disposal and burning of these fossil fuels.

5. Under these conditions, Indonesia's large base of renewable energy resources, such as mini-hydro and mini-geothermal power sites and biomass-based power generation (including cogeneration), offer economically attractive and environmentally superior alternatives for decentralized electricity generation. The renewable energy resources that have potential for development in Indonesia in the near-to mid-term are mini- hydro, biomass cogeneration, and mini-geothermal, with typical sizes of 1-5 MW. Preliminary information indicates that the potential biomass cogeneration projects -- sugar and palm oil -- would be concentrated in Java, Sumatera and Sulawesi, and that mini-hydro and mini-geothermal projects would be concentrated in Eastern Indonesia.

Barriers to development of renewable energy power projects

6. For the **private sector**, the key barriers common to the development of these resources are: (i) accessibility to and high information costs about the resource as well as the technology; (ii) a weak policy context and regulatory framework which results in a playing field that is not level, especially the lack of fair and transparent rules for the pricing of power sales to PLN's grid, lack of specific regulations to control and oversee market access and entry and, weak pricing and contract enforcement mechanisms; (iii) high transaction costs, specially regarding financing for the private producers; (iv) large pre-investment costs, relative to conventional energy projects; and (v) lack of medium-to-long-term debt financing.

7. Some of these barriers are being eliminated as a result of the Bank's policy dialogue with the Government of Indonesia and PLN. Over the preceding few years, the GOI has engaged in significant energy pricing and market reforms. In particular, a published small power purchase tariff, linked to PLN's avoided cost, and standard contract are to be implemented under a covenanted agreement reached for the Second Rural Electrification project (IBRD Ln. 3845-IND). Linking the power purchase tariff to the economic benchmark established by PLN's avoided cost ensures that only cost effective renewable power projects will be developed, thereby promoting efficient market development. Ongoing Technical Assistance financed by the Bank is assisting the Government in developing a regulatory framework that will establish a level playing field for all market participants, coupled with more detailed rules, procedures and supporting regulations to enable efficient functioning of the small power market.

8. **PLN's** dominant status in the Indonesian power sector and its extensive experience in rural electrification guarantees that it will continue to be a major player in future rural electrification. However, the development of small scale renewable energy power projects remains outside the mainstream of PLN's operations. In particular, PLN's organizational structure lacks a single focal point of responsibility or accountability for the preparation of small renewables as an integral part of the supply system development program. Further, for small renewable energy projects, PLN uses an overly cumbersome, time consuming and costly process and approach to resource assessment and updating, site screening, powerplant design, procurement and installation, typical of that used for developing large scale hydro and geothermal projects. For example, under current practices, it is estimated that PLN's preparation costs alone for small renewable power projects are in many instances as high as $300-500/kW, while the best practice costs are in the range of $50-75/kW. By contrast, PLN's cost of preparation of diesel plants is negligible given that PLN's default option is to procure and install diesel generators.

PROJECT OBJECTIVES

9. **Global objective** The global environmental objective of the RESP project is to mitigate emissions of CO_2 in Indonesia. Since diesel is the baseline fuel in PLN's rural electrification operations, the development of renewable energy sources for power generation would mitigate diesel consumption, and correspondingly, CO_2 emissions. It is anticipated that about 10.8 million tons of CO_2 emissions will be mitigated as a result of the RESP project (Annex 3).

10. The **national objectives** of the RESP project are to:

(i) catalyze the rapid penetration of grid-based renewable energy projects in the private sector -- including cooperatives and NGOs -- in the PLN network, within the framework of a least cost rural electrification strategy;

(ii) facilitate participation by the private sector in advancing renewable energy commercialization through the creation of a sustainable "market conforming" framework;

(iii) promote environmentally sound energy resource development in Indonesia and to reduce the energy sector's dependence on fossil fuels.

(iv) strengthen Indonesia's institutional capacity to sustain renewable energy development.

PROJECT DESCRIPTION

RESP Development Strategy

11. The project would facilitate development of private sector markets for small scale renewable energy power generation projects using resources such as mini-hydro, mini-geothermal and biomass-cogeneration, for sale of electricity to PLN. The proposed project would assist the market penetration of renewable energy technologies, largely by the private sector, that are "essentially commercial," but whose market penetration is delayed and constrained by factors such as high transaction costs, perceived commercial risks due to unfamiliarity with investment types, a lack of in-country experience, and the absence of appropriate term debt financing. Hence, the RESP project would "pioneer" the wide scale application of renewable energy technologies in Indonesia.

12. The project implementation strategy is to promote, in a targeted and phased manner, commercial markets for renewable energy. The longer term lending program vision is one of a series of linked projects, phased over a period of time; each seeking to build upon the lessons learnt from the predecessor project, while broadening the regional market and technology focus to new areas and newer technologies, and at the same time also seeking to further enhance the efficiency and reduce the costs of existing delivery and financing mechanisms.

13. The project consists of:

(i) **Small Private Power (SPP) Component:** Renewable energy based small electricity generation projects -- biomass cogeneration, mini-hydro, mini-geothermal -- installed and operated by private entities, and selling their output to a regional PLN grid under the published Small Power Purchase Tariff (SPPT), and standardized power purchase contract. This component includes mini-hydro and mini-geothermal resource assessments and the dissemination of such resource information to prospective developers.

(ii) **PLN Component:** Renewable energy based small power generation projects -- mini-hydro, mini-geothermal -- owned and operated by PLN. This component includes a strengthening PLN's institutional capacity to undertake small renewable power projects in a timely and cost-effective manner.

Project design

14. The RESP project's strategy is to focus on a number of selected regions that have high market potential. Whereas in principle the project would support sub-projects in all regions, the primary thrust of the Bank's project preparation activity is on developing a pipeline of potential investment sub-projects

in geographic areas with good renewable resource potential and in proximity to demand centers/regional PLN grids that have high "avoided cost" of supply.

15. The RESP project will address the key barriers to the development of renewable energy power mentioned earlier (paras 6-8). For the Small Private Power component, the RESP project will address: (i) high information and transaction costs, (ii) high pre-investment costs, and (iii) lack of financing. An additional element of the project design for this component is the preliminary identification of about 15 to 20 power projects before the project starting date. For about five of these projects, the bulk of the pre-investment activities will have been completed by loan/grant effectiveness. For the remaining projects, preliminary screening to ensure that they have good prospects will have been completed during project preparation, but significant pre-investment activities will have be conducted after project start-up.

16. For PLN, the RESP project will address barriers to effective renewable energy development by: (i) supporting the development of a limited number of renewable energy projects, and (ii) strengthening PLN's institutional capacity for renewable energy development. The efficient development and execution of a number of small renewable energy projects will put the design, planning, implementation and operation of cost effective renewable energy power projects into the mainstream of PLN's overall RE system development program. Subject to further preparation work, the PLN component will consist of: (a) construction of a geothermal power plant rated at about 3 MW at Ulumbu, Flores, and possibly a 4 MW plant at Lahendong in North Sulawesi; and (b) about 10 to 15 mini-hydro plants (10 to 15 MW in aggregate), in Eastern Indonesia.

17. For private power, the RESP project will include the preparation and provision of technical resource information to the private sector for developing small power projects on a competitive bidding basis. For PLN, the RESP project's capacity building program will focus on institutional changes within PLN that are required to support mainstreaming of the design, planning, implementation and management of a sizeable and growing small power program for rural electrification, based on renewable energy. RESP-provided technical services will also include support for a strategic planning process (including preparation of tactical plans for each resource option) in order to facilitate decision-making by key players and appropriate allocation of limited financial resources.

ENVIRONMENT AND RESETTLEMENT

18. The proposed project will consist of numerous, and very small sub-projects utilizing renewable energy technologies such as biomass cogeneration, mini-hydro, mini-geothermal that have relatively little adverse effects on the environment. . While no individual sub-project is likely to result in significant environmental or resettlement problems, each project will be carefully examined during project preparation to avoid adverse environmental impacts. The proposed project's environmental impacts are classified as "B", and an Environmental Analysis (EA), as required by Bank guidelines, will be undertaken to identify local environmental and resettlement impacts of proposed project activities and to propose remedial actions. Further, existing industries or any other developer that will seek financing through this project will have to prove compliance of on-going operations with existing relevant national environmental regulations for all aspects of their operations. The monitoring and evaluation system to be supported by the project would monitor potential environmental impacts of small-scale renewable energy projects in order to take prompt corrective action, should adverse impacts be detected during implementation.

RATIONALE FOR BANK INVOLVEMENT

19. The World Bank's Indonesia Country Assistance Strategy (CAS) (presented to the Bank's Board on February 27, 1995) includes a commitment to assist the Indonesian authorities in developing the country's renewable energy resources. The proposed project design and implementation strategy typify the defining characteristics of the transition that is underway in the assistance strategy for Indonesia: (i) achieving poverty reduction through increased funding for regional development, and a shift towards smaller and regionally oriented projects targeted at reducing urban-rural disparities in the quality of life; and (ii) striking an appropriate balance between public and private roles in energy distribution.

20. The Bank continues to actively support implementation of an efficient and sustainable Rural Electrification (RE) program, initiated in the Rural Electrification I project and now through the successor Rural Electrification II project; primarily by financing extension of the various regional grids, and supporting institutional capacity building. Renewable energy power generation options represent key elements of the overall least cost RE strategy in Indonesia and complement the least cost grid extension program for RE. The constraints to efficient delivery of rural electrification are related to broader power sector development issues as well as PLN reorganization, on which the Bank has established a close working relationship with the Government and PLN. The proposed project will provide a means to continue this dialogue and to support the implementation of a sustainable and environmentally sound RE development program, which also encourages private sector participation and the creation of commercial markets for alternative energy. The RESP project is also expected to continue the process of improving the policy, regulatory and institutional environment, all matters of high priority on the Bank's agenda.

RATIONALE FOR GEF FINANCING

21 The RESP Project is eligible for GEF support under the 1995 interim guidance approved by the GEF Council, and is consistent with the renewable energy market penetration aims embraced by the draft GEF Operational Strategy. Project activities proposed for GEF funding aim to remove institutional and information barriers which prevent economically least-cost renewable electricity sources from being exploited. The RESP project is a priority item in the Indonesian Government's Energy Strategy, and RESP project activities provide the means for abating GHG at a cost below US$ 1 per ton CO_2 (Annex 3).

22. Indonesia ratified the FCCC on August 23, 1994, so that it is eligible to receive GEF funds under this convention. In order to help fulfill its FCCC national communication commitments, Indonesia has initiated two greenhouse gas mitigation strategy studies. The Asia Least-Cost Greenhouse Abatement Strategy Project (ALGAS), funded by GEF/UNDP, examines Indonesia's GHG emission reduction options in an Asian regional context. Indonesia is also a participant in the second round of study activities financed under the US Country Studies Program. Although both studies are still at early stages of implementation, the relevance of grid-connected renewable energy systems as a greenhouse abatement option for Indonesia is clear. As least-cost alternatives, the zero or very low carbon renewable systems directly substitute for coal and oil fired generation at very low marginal abatement costs.

SUSTAINABILITY AND PARTICIPATION

23. The primary stakeholders in the project are: private sector small power project developers, PLN, Directorate General of Electricity and Energy Development, the Planning Agency (BAPPENAS), and the Ministry of Finance. All stakeholders have been and continue to be involved to varying degrees in project preparation. A well-attended public launch meeting, co-sponsored by the Ministry of Energy and the

Chamber of Commerce was held in March 1995 to publicize and discuss the RESP project. A number of meetings have been held with the Sugar Council and the Palm Oil Association to stimulate the interest of their members in biomass cogeneration projects. As a result of these contacts, consultants financed by Bank-managed trust funds have already visited a number of potential participants. Discussions with PLN have been ongoing as part of the Bank's continuing dialogue, and specifically for the establishment of the published small power purchase agreement and tariff.

24. The RESP project will lead to a long term sustainable renewable energy small power sector. Within PLN, a shift to timely and cost effective preparation of small renewable projects will be a key step in achieving sustainability. Further, changes in PLN's management framework and organizational setup will bring renewable energy projects into the mainstream of PLN's activities. For the private sector, the demonstration effect of commercially viable private projects included in the RESP project will stimulate further private sector participation. In addition, sustainability will be made possible by introducing supporting rules, regulations and procedures in connection with the published small power purchase tariff and enforcing the same. Under the project, developments in the small power market will be monitored and, if necessary, the implementation rules and regulations supporting the published small power purchase tariff would be revised as appropriate. This supportive regulatory framework, coupled with resource assessments that would be made available to the private sector are expected to lead to financial viability in the medium term.

LESSONS LEARNED AND TECHNICAL REVIEW

25. Given the Bank's limited involvement in renewable energy projects, there are no relevant Bank reports on past projects. Ongoing experience is limited to the IBRD/GEF-financed India Renewable Energy Development Project (Ln. 3544-IN/Cr. 2449-IN), in which the supported technology is wind power, and not the technologies supported by the RESP project.

26. Experience in other countries (Costa Rica, Guatemala, and Pakistan) indicates that private developers require initial support in the form of a financial incentive, and continued proactive participation in order to stimulate response in markets that have had no experience in the particular area of grid supply private power development with small scale renewable resources.

27. **Technical review** The project was reviewed in August 1995 by an independent external expert, selected from the STAP roster, who has practical experience with the development of renewable energy resources; his detailed comments are attached as Annex 2. His main comments were that the project: (i) is relevant and addresses the key issues, (ii) is cost-effective in reducing greenhouse gas emissions, (iii) is well-designed, (iv) makes a compelling case for GEF support, but (v) underestimates the challenge and frictional losses involved in implementation. To deal with anticipated implementation challenges and increase the likelihood of project success, he therefore recommended that technical support services be expanded to include support for an effective strategic planning process, including preparation of specific tactical plans for each resource option (eg, modular geothermal, hydro, and biomass). These recommendations have been incorporated in the revised project brief, and will be addressed in detail during final project preparation.

PROJECT FINANCING AND BUDGET

28. The total cost of the project is $168 million, of which the Small Private Power component is $105 million and the PLN component is $63 million. A preliminary financing plan, disaggregated by compon-

ent and source of financing -- IBRD, GEF, PLN, and private sector -- is contained in Annex 1. Investment in the Small Private Power component will be financed by a combination of IBRD and private funds at $50 million each, while investments in the PLN component will be financed a combination of IBRD ($50 million) and PLN ($10 million) funds. The pre-investment, project support (including strategic planning), and resource assessment costs in the Small Private Power component will be financed by a combination of GEF ($4 million) and private ($1 million) funds, while PLN's capacity building will be financed by a combination of GEF ($2 million) and PLN ($1 million) funds.

29. **Onlending arrangements.** For the PLN component, IBRD credit will be provided under the standard on-lending arrangements already agreed to under the Second Rural Electrification Project wherein PLN also assumes the foreign exchange risk. For the Small Private Power component, IBRD credit would be onlent in rupiah through the Ministry of Finance or Bank Indonesia (BI) to state or private commercial banks, at market rates. These participating banks would not be pre-selected or individually appraised by the Bank. Rather the project developers would initiate loan applications at commercial banks of their own choice -- but who must be rated as financially healthy by BI -- to obtain rupiah loans at market rates, with terms typically ranging between 8 to 12 years. The commercial bank would be responsible for appraising the sub-loan applications, and would bear the commercial risk for the sub-loan.

INCREMENTAL COSTS

Small Private Power

30. **Baseline** At present, there is no private sector development of renewable energy resources in Indonesia, though the publicity related to the RESP project has elicited private sector interest. Frequent discussions with potential entrepreneurs have made it clear that they are unable or unwilling to undertake the required significant pre-investment activities without external financial and/or technical incentives and support, given the pioneering nature of small renewable energy power projects in Indonesia.

31. Potential private participants in small hydro and geothermal power projects face the difficulty that there does not exist any readily available database with technical information related to prospective sites. This lack of information is a well-known example of market failure in the information market, since the value of the information about a particular site is greater for society as a whole than for an individual private developer.

32. Thus, in the absence of the RESP project, there would be limited, if any, private sector renewable energy development, even where potential projects have excellent prospects for financial viability. When the standardized small power purchase tariff is enacted (expected to take place in the next few months), it is likely that private developers will begin to initiate small scale power projects, based on relatively standard technologies (such as diesel), over the project period. It is estimated for the purposes of the baseline that private developers would probably be willing to put in about $1 million into the pre-investment costs of such power generation activities.

33. **GEF Alternative** With GEF assistance, it is expected that about 15-20 small-grid supply renewable based energy projects will be undertaken by private developers. Since information availability and perceived risk are the major barriers to RESP activities in Indonesia, the costs of the pre-investment activities and resource assessments required for sustainable development of this sector form the starting point for estimating incremental costs. It is estimated that the cost of engineering and environmental expertise

necessary to assist with pre-investment activities, to develop a strategic planning framework, and to collect information on potential sites would cost about $5 million.

34. **Incremental Costs** The incremental costs of the proposed pre-investment and resource assessment activities are equal to the costs of the GEF Alternative less the counter-factual private sector expenditures. On this basis, given that the total cost of the activities is $5 million, and the counter-factual private sector expenditure is $1 million, the GEF incremental costs are $4 million.

PLN

35. **Baseline** While PLN does undertake some small renewable energy projects, its standard procedure is to install diesel-based generation. PLN's high project preparation costs, cumbersome processing procedures, and the lack of an appropriate focal point suggest that PLN is not organized or equipped to promote renewable energy development above a minimum level of activity. Under the baseline scenario, it is therefore assumed that PLN will undertake few small renewable energy projects in the absence of the RESP project. The institutional expenses that would be incurred in developing this additional generation capacity for rural electrification are estimated at about $1 million over the RESP project period.

36. **GEF Alternative** With GEF assistance, it is expected that PLN will install between 10-15 mini-geothermal/mini-hydro plants. The incremental costs for this investment program are the costs of the institutional changes and capacity building required to mainstream renewable power projects within PLN. These activities, consisting of a diagnostic study, action plan, and implementation of action plan recommendations, are estimated to cost $3 million. On this basis, a GEF grant of $2 million is requested to cover the incremental costs of the institutional change and project support, with a PLN contribution of $1 million, based on the counter-factual expenditures.

ISSUES, ACTIONS AND RISKS

37. **Key policy reforms/related conditionalities sought** The following are among the principal agreements that would be sought from PLN during project appraisal: (i) periodic review, update, and revision as appropriate, of the published small power purchase tariff, the standard power purchase contract, and the relevant regulations, to redress any factors that are found to be significantly impeding the pace or scale of development of the renewable small power market; (ii) all sub-projects are to meet the agreed guidelines for environment and resettlement screening and mitigation; and (iii) taking into account the recommendations of a consultant study on the organizational, technical and other changes required to mainstream small renewables development within PLN on a cost-effective basis, PLN to develop and implement a time bound action plan satisfactory to the Bank to implement the said changes.

38. There are some risks associated with the private sector component of the project. First, there are, potentially, technical, implementation and operational risks associated with the renewable energy technologies utilized by the private sector. These risks will be minimized by limiting technology choices to those that have already been proven under actual operating experience in Indonesia or elsewhere. Further, the implementation and operational risks will be addressed by a Project Support Unit (established for this purpose) and initiation of a strategic planning process. Second, there are risks associated with lack of commercial bank, and private developer interest in financing projects utilizing the credit available under this project. This risk will be minimized by the identification and preparation of bankable investment projects prior to project start-up. No significant technical risks are foreseen with respect to the PLN

component of the project; potential problems in project implementation will be addressed by the Project Support Unit.

INSTITUTIONAL FRAMEWORK AND PROJECT IMPLEMENTATION

Implementing and oversight agencies

39. The Directorate of Private Power, located in the Directorate-General of Electricity and Energy Development, will be the implementing agency for the Small Private Power component, though the actual execution of individual power projects will be undertaken by independent private developers. Since the Directorate of Private Power has been established by the Government of Indonesia to be a focal point for private power producers, this Directorate is the appropriate local counterpart agency. PLN is the implementing agency for the PLN component of the RESP project.

40. Local oversight will be provided by the Rural Electrification Steering Committee, headed by the Director-General of Electricity and Energy Development (DGEED). A Working Group, composed of representatives of DGEED, the Planning Agency, Ministry of Finance, PLN, and the Chamber of Commerce may be set up to review the RESP project's progress and provide a forum for inter-agency discussion and coordination.

Monitoring and Evaluation

41. The critical success factors for the Small Private Power component are: (i) timely and cost-effective completion of pre-investment activities, (ii) timely commissioning of the renewable energy projects, (iii) reliable operations at expected output levels, (iv) a harmonious : lationship with PLN, including timely payments by PLN, and (v) the development of a publicly available database related to potential hydro and geothermal sites. The critical success factors for the PLN component are: (i) timely commissioning of the renewable energy power projects, (ii) reliable operations at expected output levels, (iii) changes in renewable power project preparation so that the cost and time are reduced, and (iv) the establishment of a focal point related to renewable power projects. Specific performance indicators and institutional responsibilities for managing the monitoring and evaluation system will be defined and agreed during project appraisal.

Annex 1

INDONESIA: RENEWABLE ENERGY SMALL POWER (RESP) PROJECT
FINANCING PLAN
(US$ million)

Component

	IBRD	GEF	Private Sector	PLN/ GOI	TOTAL
Small Private Power (SPP)					
Direct Investment	50	0	50	0	100
Pre-investment costs, Project Support Unit (shared with PLN), Resource management and assessment	0	4	1	0	5
Sub-Total	50	4	51	0	105
PLN					
Investment	50	0	0	10	60
Capacity building and resource assessment, Project Support Unit (shared with Private Power)	0	2	0	1	3
Sub-Total	50	2	0	11	63
Project Total	**100**	**6**	**51**	**11**	**168**

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Indonesia: Renewable Energy Small Power (RESP) Project

Incremental Costs and Global Environmental Benefits

Broad Development Goals

1. Indonesia's basic goals and policies for the development of the energy sector highlight the importance of meeting Indonesia's rapidly growing energy needs in an efficient manner, including through conservation and diversification of primary energy resources, and minimizing the adverse environmental and social impacts of energy use. A key and continuing thrust of the Government's energy strategy is to slow down Indonesia's transition to net oil importer status by diversifying energy supply for domestic consumption towards alternative and economic indigenous resources that have a non-exportable surplus or are non-tradeable, such as renewable energy. Rural electrification (RE) is a key and integral part of the Government's rural development strategy.

Baseline

2. In Indonesia today, the supply of electricity to rural households depends heavily on diesel-based generation. The national power utility (PLN) owns and operates over 5,000 diesel plants scattered throughout Indonesia -- about 2,000 MW of diesel generating capacity -- as a primary means to supply power for rural electrification. Further, in PLN's present rural electrification plans, the default option is to add diesel-based generation capacity. At present, PLN has high project preparation costs and cumbersome processing procedures for small renewable power projects, and PLN's organizational structure lacks a focal point for such projects. Further, in Indonesia, at present, there are no private small renewable energy power projects that sell their output to PLN.

3. In these circumstances, the baseline course of action is that PLN will continue to rely on diesel-based generation for rural electrification.

Global Environmental Objective

4. The baseline course of action will lead to significant emissions of greenhouse gases (CO_2). Thus, the global environmental objective of the RESP project is the mitigation of GHG emissions.

GEF Alternatives

5. The renewable energy power projects developed under the RESP project represent the least-cost option. The private producers clearly have an incentive to minimize their costs, and these will be less than PLN's avoided costs, since the private producers will sell their output to PLN on a tariff based on PLN's avoided costs. From the global environmental perspective, the costs of GHG abatement are low since the private producers need GEF support only in the initial phases of developing their projects, and since they are able to bear part of these initial development costs.

6. PLN's small renewable power projects developed under the RESP project do not need GEF support. Thus, from the global environmental perspective, the only costs of GHG emission abatement are those related to capacity building and institutional change within PLN to mainstream small renewable energy power projects.

System Boundary

7. The RESP project is expected to have programmatic benefits, in addition to the project benefits, by demonstrating the financial viability and least-cost nature of renewable energy small power projects both within and outside PLN. In other words, the RESP project will accelerate the penetration of renewable energy small power projects.

Additional Domestic Benefits

8. There are no additional domestic benefits beyond progress towards least-cost provision of electricity to rural consumers.

Costs

9. **Small Private Power component** The GEF incremental cost of this component arises from two types of activities: (i) support for the pre-investment activities of the private developers as well as guiding and coordinating the power projects through the preparation/development phase in the first two years of the RESP project, and (ii) resource assessment and management that would not be undertaken by any private individual developer.

10. Pre-investment activities The Indonesian project developers will have to hire engineering and environmental firms for pre-investment activities, as there is no precedent in Indonesia for the implementation of small grid supply renewable energy based projects. It is estimated that the pre-investment costs to the potential developers will be in the range $ 100,000 to $250,000, excluding internal staff time contributed by the developers. It is expected that about 15 projects would need support for pre-investment activities, for a total cost in the range of $2.0 to $3.0 million.

11. Support activities There is also a need for a small Project Support Unit (PSU) in Indonesia that will serve as the guide, manager, coordinator, and trainer for moving the renewable energy projects through the preparation/development/implementation process. A lean PSU staffed for the two years with one expatriate expert supported by limited short term expatriate experts is expected to have a budget of about $1.5 million. As the PSU would be working closely with the Directorate of Private Power and PLN and additional resources will also be allocated to allow these entities to develop the inhouse capability to take over and maintain the PSU functions. After the RESP project is over, the PSU will be disbanded and its activities taken over by PLN and the Directorate of Private Power.

12. The total cost of the pre-investment and support activities is $3.5 million. The counter-factual expenditure of the private developers is based not on renewable energy development but on the business activities that the developers would have otherwise undertaken: this amount is estimated to be $1 million. On this basis, the GEF incremental costs are $2.5 million.

13. Resource management and assessment Private developers of small hydro and geothermal resources face an inhibiting factor that impedes the timely evaluation and implementation of viable power projects: lack of information about potential sites. Over the years, PLN has assembled an inventory of hundreds of potential small hydro and geothermal project sites, but the level and quality of the inventory information assembled varies considerably, and it lacks the organizational structure needed for an efficient commercial assessment, integration, and prioritization process that is mandatory, if such inventory is to be disseminated to potential developers in a useful form. Under the RESP project, the available

information will be collected, collated and packaged so that it is usable by potential private developers. This database related to hydro and geothermal resources is expected to lead to a significant number of renewable energy small power projects.

14. The estimated cost of this database activity is $1.5 million. Given that no private developer can undertake this or some similar activity, the GEF incremental cost is also $1.5 million.

15. Subtotal Thus, the GEF incremental cost for the Small Private Power Component is $4 million.

16. **PLN** For PLN, the specific activities undertaken would include a diagnostic study, the development of an action plan, and its implementation, which may include some elements of training. The detailed terms of reference for the diagnostic study will be developed during the course of further preparation work. In addition, PLN's implementation of small renewable energy projects would also be supported by the Project Support Unit. It is estimated that the total cost of these activities would be $3 million. The counter-factual expenditure by PLN is assumed to be $1 million. Thus, the GEF incremental cost is $2 million.

17. **Total** The GEF incremental cost is $4 million for the Small Private Power component and $2 million for the PLN component, for a total of $6 million.

Global Environmental Benefits

18. The overall avoided emissions are about 10.8 million tons of CO_2, with a total GEF grant of $5 million, leading to a GEF unit cost of about $0.55/ton CO_2 (Tables 1-3). The estimates of the emissions avoided include both the emissions avoided from investments directly supported ("project effect") by the RESP project as well as the investments indirectly accelerated ("programmatic effect") as a result of the RESP project. In other words, the impact of the RESP project is measured as the difference between the market penetration of the renewable energy technologies with and without the RESP project.

19. For all of the renewable energy technologies, the estimation of total emissions avoided starts with an estimate of the unit emissions avoided factor (Table 4). Given the likely location of the generation facilities, it is assumed the renewable energy technologies will substitute for: hydro primarily for diesel-based regional grids, i.e., the larger provincial grids and diesel-based mini-grids, i.e., smaller provincial grids that supply relatively isolated communities; geothermal primarily for the regional grids; and biomass primarily for the regional grids and the Java-Bali grid. Based on these substitutions, the avoided emissions are calculated in terms of CO_2 tons/Gwh. The estimated values are: (i) hydro: 740 tons CO_2/Gwh; (ii) geothermal: 760 tons CO_2/Gwh; and (iii) biomass cogeneration: 700 tons CO_2/GWh.

20. The unit avoided emissions factors are multiplied by the estimated penetration of the technology to arrive at the total emissions avoided. The estimated penetration is based on the projects directly supported by the GEF grants as well as the accelerated penetration induced by the GEF supported activities.

Table 1

Table 1

Indonesia Renewable Energy Small Power (RESP) Project

Avoided CO_2 Emissions and Costs

GEF Supported Activities	Emissions Avoided Project and Programmatic ('000 tons CO_2)	GEF Contribution US$ million TOTAL	Unit Cost US$/ton
Small Private Power: Minihydro, Biomass Cogeneration Pre-investment studies, other support, resource assessment	7,610	4	$0.53
PLN: Minihydro, mini/micro geothermal Institutional development	3,250	2	$0.62
TOTAL PROJECT	10,860	6	$0.55

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Table 2

Indonesia Renewable Energy Small Power (RESP) Project
Small Private Power

GEF Costs				$ million	4.00
		Hydro (mini)	**Geothermal (mini/micro)**	**Biomass**	**Total**
Direct Project Benefits					
Project Capacity Implemented	MW	5	0	75	80
Avoided CO2 Emissions	000 tons CO2				
Life Time (undiscounted)		530	0	4,140	4,670
Programmatic Benefits - Accelerated Market Penetration					
Multiplier Effect - Increase as	% of Project MW's	200%	200%	200%	
	MW Increase	10	0	150	
Timing Effect	years accelerated	5	5	5	
Total Effect (very approx.)	MW-years	50	0	750	
	GWH	240	0	3,940	
Avoided CO2 Emissions	000 tons CO2				
Programmatic		180	0	2,760	2,940
Direct Project and Programmatic Benefits		**710**	**0**	**6,900**	**7,610**
Avoided CO2 Unit Cost	$/ton CO2				$0.53

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Table 3

Indonesia Renewable Energy Small Power (RESP) Project
PLN

GEF Costs — $ million — 2.00

		Hydro (mini)	Geothermal (mini/micro)	Biomass	Total
Direct Project Benefits					
Project Capacity Implemented	MW	15	6	0	21
Avoided CO2 Emissions	000 tons CO2				
Life Time (undiscounted)		1,600	840	0	2,440
Programmatic Benefits - Accelerated Market Penetration					
		200%	200%	200%	
	MW Increase	30	12	0	
Timing Effect	years accelerated	5	5	5	
Total Effect (very approx.)	MW-years	150	60	0	
	GWH	720	370	0	
Avoided CO2 Emissions	000 tons CO2				
Programmatic		530	280	0	810
Direct Project and Programmatic Benefits		2,130	1,120	0	3,250

Avoided CO2 Unit Cost — $/ton CO2 — $0.62

Table 4

Indonesia Renewable Energy Small Power (RESP) Project:
AVOIDED CO_2 EMISSION BENEFITS - Unit Factors (a,b)

		Hydro (mini)	Geothermal (mini/micro)	Biomass (c)
A. Renewable Energy Technology Characteristics				
Implemented Capacity	MW	1	1	1
Plant or Capacity Factor		0.55	0.70	0.60
Plant Life	year	30	30	15
Electricity Generation				
Annual Generation	GWH/year	5	6	5
Life Time Generation	GWH/life	145	184	79
Renewable Energy CO2 Emissions (b)				
Unit Emission Factor	tons/GWH	0	50	0
Annual Emissions	000 tons/year	0	0	0
Life Time Emissions	000 tons	0	9	0
B. Substitute Technologies				
Avoided Technologies and Unit Emission Factors				
Java-Bali Grid	tons/GWH	600	600	600
Diesel-based Regional Grids	tons/GWH	700	700	700
Diesel-based Mini-Grids	tons/GWH	850	850	850
Mix of Substitute Technologies				
Java-Bali Grid		15%	0%	30%
Diesel-based Regional Grids		50%	25%	50%
Diesel-based Mini-Grids		35%	75%	20%
Substitute Technology CO2 Emissions - weighted average of substitute mix				
Unit Emission Factor (wgt ave)	tons/GWH	740	810	700
C. Avoided CO2 Emissions	(difference between renewable and substitute technologies)			
Net Avoided Emissions Factor	tons/GWH	740	760	700
Avoided CO2 Emission Quantities - 000 tons net				
Annual	per unit capacity	3.6	4.7	3.7
Life Time		107	140	55

(a) See Attachment 1 for background information on renewable and substitute technology factors.

(b) Only direct CO2 emissions are included in this analysis. The global warming potentials of other gases and of CO2 and other gases embedded in the manufacture, transport, etc. of the technologies are not included. Consequently, in most cases, these limitations lead to a conservative estimate of the avoided emissions from renewables. One exception is the geothermal emission factor which does include more than direct CO2 emissions.

(c) The biomass emissions factor of 0 assumes that the resource is produced on a sustainable basis. Furthermore, it does not include consideration of incomplete combustion issues that could lead to non-CO2 emissions with global warming potential.

ANNEX 2

August 29. 1995

Subject: Review of Global Warming Proposal (Indonesia: RESP Project)

My response to the assignment

o Comments on proposals and materials reviewed.

i) The project is not only relevant to global warming mitigation, but addresses the most problematic issue, i.e. the need to develop energy infrastructure in emerging economies without penalizing these economies economically and/or imbedding in these economies an addiction to greenhouse gas producing technology.

ii) The project meets the stated criteria for cost-effectiveness in reducing greenhouse gas emissions. As a globally applicable template, its value will dwarf its cost, if it suceeds in clearly demonstrating the economic and other advantages of renewable based distributed generation.

iii) Project design at the level presented flawlessly incorporates relevant experience.

iv) There is no apparent basis to question the project's feasibility. The project's goal, however, is as ambitious as it is important, i.e. to create an energy supply and delivery infrastructure and market that does not currently exist. one that is complex and demanding of talent and capital and presents a threat to vested institutional and corporate interests. If the project concept has a flaw, it is the potential to underestimate the challenge and frictional losses involved in implementation. The project invests in making critical information and organizational capability available. This is necessary, but good information on feasible and attractive options does not, per se, guarantee wise choices.

o Case for the grant. The case is clearly made. The global strategic importance of the project makes it compelling.

o Scientific and technical merits. The concept has as its major strength the involvement of PLN, private sector parties and national planning agencies. Its weakness is that its rewards will not be immediate. and it will be a candidate for benign neglect in the context of larger and more immediate problems and opportunities facing the major players. The following specific actions could address the weaknesses and challenges mentioned above:

1. **The philosophy of project execution must one of healthy pessimism**, i.e. to take nothing for granted, to address the hard problems first, leaving the easy problems for later. Most projects of this type fail because the people assigned to them do what they are trained or qualified to do rather than deal with the unique and unprecedented problems whose solution is critical to success.

2. Without a fairly detailed strategic plan, it will be difficult to differentiate between practical show-stoppers and conceptual optimization issues. **An effective**

strategic planning process will force decisions that result in buy-in by key players and appropriate allocation of limited resources.

3. Although modular geothermal, hydro and biomass power plants have comparable macro-economic and operational parameters, they involve fundamentally different resources converted by fundamentally different technologies. Within the strategic planning framework recommended here, **preparation of specific tactical plans for each resource option would be advisable** if not imperative.

Notes. The following notes identify issues that should be addressed by overall strategic or resource-specific tactical plans or plans for specific distributed renewable generation projects.

1. Utility planning and operational context. Distributed renewable generation is more a natural tool of the transmission and distribution system operator than the central generation system operator. Within a vertically integrated utility, the unit responsible for centralized generation typically cannot appropriately adapt its planning processes and operational methods to distributed generation, whereas the operating units that typically deal with smaller scale projects and customer needs are better able to evaluate and execute.
2. Drivers of basic economics.
   - Capital for project development and execution. Always underestimated.
   - Fuel. Costs of prospecting, validation, contracting, delivery, and resource maintenance are often ignored or underestimated.
   - O&M. Savings achievable through standardization, e.g. training, spares, shorter overhaul period, can be significant.
3. Private investment criteria.
   - Low or no technology risk
   - Low or no fuel risk
   - Fast capital recovery
4. Planning issues. Optimum economics are achieved at the system level, not at the level of the generating plant, i.e. distributed renewables must be designed and operated to complement existing diesel generators and vice versa. Marginal cost pricing as described in the proposal typically undervalues capital intensive renewable resources. Only adoption of real time cost of service pricing at the retail level will result in a truly level playing field.
5. Institutional issues. The existance of publicly owned utilities favors renewable resource development, because such entities are well adapted to execute infrastructure investments. Market frameworks for private power favor fuel based options, because they drive fuel markets to greater short term efficiency at the expense of infrastructure investments. Capital intensive renewable generation is more heavily taxed in some countries, e.g. the US, than fuel based generation.
6. Techology issues. Typically, 1-5MW is sub-optimal modularity for thermal generation, except where delivery capacity of grid is limited. Limiting choices to technologies already proven in Indonesia may be overly restrictive. Overall program should be structured to encourage in-depth study of relevant project experience outside of Indonesia.