Country Report
THE PROSPECT OF SMALL HYDRO POWER DEVELOPMENT
IN INDONESIA

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1. INTRODUCTION

The development of energy systems has been the backbone of global economic growth since the industrial revolution in the mid-19th century. These energy systems have not advanced based on market strength alone. In several countries they have been developed as 'strategic vision' products, where incentive-induced private investments and government policies have resulted in complex energy networks and industries. This strategy currently dominates the development of a future energy system that stresses the use of fossil fuels.

On the other hand, environmental awareness, sustainable development and conventional resources depletion are now forcing governments to review their energy strategies. Coal and oil burning damages the earth and creates health problems. Particulate and dust are emitted by fossil fuel combustion, creating local health hazards, and causing widespread smog and acid rain.
The release of carbon dioxide (CO2) as a by-product of fossil fuel combustion has

been pinpointed as a major cause for the earth's climate change. Atmospheric CO2 concentration has amplified by more than 30% since the beginning of the industrial revolution. Coupled with the release of other greenhouse gas (GHG) concentrations, this upsurge has threatened human welfare and well being through the spread of infectious diseases, heat waves, storms, drought and flood, rise in sea level and coastal flooding.

The fossil fuel subsidy has added substantially to the government's national debt, reduced government revenues from potential oil export and created inefficiencies in the nation's economic growth. Plans to gradually reduce subsidies are underway. The subsidized fuels encourage excess use of the fossil fuel and do little to influence efficiency, which in turn reduces working opportunities and creates unequal distribution of income and welfare of the community.
Further, fossil fuel dependency has rapidly diminished national oil reserves. Indonesia is set to become a net oil importer within the next ten to twenty years. Without the support of prudent energy system strategy, Indonesia may face another economic turmoil should oil crises happen in the future.
If the current paradigm of energy use is continued, Indonesia will be a major contributor to the deterioration of the global climate and local environment, as well as health and welfare of the community. Therefore, adoption of a new paradigm on the supply and use of energy is essential. This paradigm should ensure health, welfare, and sustainability of our future generation, encourage active participation of society to elevate the quality of life and their environment, and extend the involvement opportunities for the private sector and non-governmental organizations.

1.1. Background

The Republic of Indonesia is the world's largest island nation, with a population of more than 200 million spread over more than 17'000 islands (about 6'000 of which are permanently inhabited). The nation lies astride the equator, and stretches for more than 5'000 km from the west to east. The principal island areas of Indonesia include densely populated Java, with 58 percent of the nation's population on 7 percent of the land; Sumatra; Kalimantan sharing the

island of Borneo with Malaysia and Brunei; Sulawesi; and Irian Jaya sharing the island of New Guinea with Papua New Guinea. Other islands include Bali, the densely populated tourist destination; Batam and Bintan in Riau Province near Singapore; and Lombok, Sumbawa, Flores, West Timor, Ambon, Seram, and Halmahera in the eastern provinces.

Indonesia comprises extensive coastal plains with mountainous terrain inland, formed by volcanic action and tectonic uplift. Smaller islands have been formed by volcanic activity, coral growth and uplift. The climate is tropical, with hot and humid weather year round. Temperature decreases with elevation in the mountains. Rainfall is heavy in most areas, with seasonal patterns influenced by monsoon winds from Australia and the Indian Ocean. Precipitation generally increases with elevation, and is heaviest in most parts of Indonesia from December to March.

The collapse of the Rupiah in late 1997 and early 1998 caused Indonesia's GDP to contract by 14% in 1998 as a result of Indonesian firms' reliance on short-term dollar-denominated debt and high levels of non-performing loans in the banking sector. The Indonesian government is committed to implementing an extensive series of reforms and a bank capitalization program, but progress has been slow, leading to further losses in investor confidence and outflows of capital. Inflation, which peaked at 77% per annum, is now significantly lower. Signs of slow economic recovery are now appearing. To date, however, political uncertainty continues in Indonesia, corruption is still rampant and the banking system remains in tatters, with defaulted loans totaling many billions of US Dollars to be restructured and new credit still almost unavailable.

1.2. Electric Power Sector Characteristics

The electrical power sector in Indonesia is dominated by the government-owned electric company PT. PLN (Persero). Another important issue to be discussed is how this monopoly will affect the deployment of renewable energy resources in bulk power markets. There is a need, for example, for regulation of retail electricity. Suppliers should create economic incentives that promote full consideration of renewable technologies for bulk power, distributed generation, and demand-side applications. On the other hand, wholesale competition is not

likely to favor renewable energy in bulk power markets. Compared with long-term bilateral power purchase agreements, short-term or spot markets make it more difficult to finance and develop renewable generation options.

At present, the electric power sector in Indonesia is heavily subsidized. The subsidies on energy were originally established as part of a social development policy. The monetary crisis in 1997/98, however, completely unbalanced this system of subsidies: while the retail electricity selling tariffs could only be raised marginally due to the difficult political situation in the country, the power production cost increased tremendously. One reason is that PLN had signed power purchase agreements with 27 Independent Power Producers (IPPs), under which it had agreed to pay for power supplies in US Dollars.

The sharp drop of the Indonesian Rupiah against the US Dollar has rendered PLN unable to meet the financial obligations to the IPPs and, as such, it is now seeking to renegotiate the contract terms. Another reason is that PLN has to purchase the gas for its power plants, as well as most spare parts at world market prices in US Dollars.

This has left PLN in a highly uncomfortable situation with huge foreign debts and unable to serve its loans in US Dollars on one hand, and legal suits by a number of IPPs and lenders on the other hand. The ongoing restructuring process within PLN, and the uncertainty regarding its ownership (governmental or private) further complicate PLN's situation. As a result, PLN is currently unable to implement new projects and to add to its power generating capacity.

As of March 2001 the state company PLN had identified 29 critical areas prone to rotating power cuts due to a lack in generating power. PLN is currently unable to add to its power generating capacity due to its financial constraints. The lingering disputes between PLN and the IPPs over contracts have damaged the bankability of the state company in the eyes of the world's financial community and made it almost impossible for PLN to raise offshore financing for its investments.

1.3. Rural Electrification

Indonesia has been committed to rural electrification for many years. Into the 1990's, PLN maintained an aggressive campaign to extend its main grids and to

establish small grids in isolated areas to serve an increasing percentage of the population.
Progress in electrification is reported on a village basis. As of March 2001, about 79 percent of villages had been electrified. The rural household electrification percentage on the other hand is only 41 percent. These figures indicate that, although PLN has achieved a fairly high village electrification rate, a large number of households still remain without electricity supply. This is mainly due to the large distance of many houses from the main line and the lack of funds by PLN to expand their distribution lines within each village system.
The PLN grid extension program has become increasingly costly as a result of: 1) the increasing cost per customer for transmission and distribution as more remote areas are electrified; 2) the high cost of supplying fuel to diesel generators serving isolated small grids; 3) the small amount of electricity consumed by customers in rural areas and the subsidized rates, making recovery of capital expenses using the traditional electrification model very difficult.
As of March 2001, the total number of villages still not connected to a PLN grid was more than 10'000, with an estimated 20 million people. As a result of the continuing economic crisis and PLN's financial collapse, the government has now been forced to reduce annual expenditure in the village electrification program.

1.4. Privatization

The current centrally planned, state-owned electric power system will gradually give way to privately owned and managed generation, transmission and distribution companies. These changes are intended to reduce public debt, enhance accountability, and improve consumer service. Privatization is unlikely by itself to increase the market share of renewable energy. Privatization can promote renewable energy by introducing new capital. On the other hand, higher discount rates and short time horizons of private investments may favor non-renewable energy-based business endeavors.

1.5. Power and Energy Cost Structure

At present, the price of electricity to end-users (retail tariff) is heavily subsidized in Indonesia. The average long-run marginal cost (LRMC) of electricity supplied to the costumers by PLN for production cost is estimated at IDR 600 (USD 0.060)

per kilowatt-hour (kWh). At the same time, the national selling price for power averages at IDR 350 (USD 0.035) per kWh. Retail tariffs are uniform throughout Indonesia, without regard to the variation in costs of generation, transmission, and distribution in different regions.
PLN currently purchases excess power from captive or community power plants on a case-to-case basis at up to 80% of the retail electricity tariff. Being aware of its inability to increase its production capacity and meet the growing demand, PLN currently also shows interest to purchase electrical power from IPPs. The purchase tariff offered, however, is not taking into consideration the real long-term production cost of PLN's own generation in the respective area, and currently is far too low to be attractive for IPPs.

1.6 Hydropower Resources

Hydro power potential in Indonesia is 75.000 MW, potential for small hydro power is 7,500 MW (10%) and 200 MW has been developed. Small hydro potentials is distributed around the islands, can be develop as Local Energy Resources especially in remote areas for Rural Independent Power Supply.

Several small hydropower projects have already been identified in the country. A study of JICA conducted in the early nineties has identified around 10 small-scaled hydropower projects for the Ministry of Cooperatives.
PLN mini-hydro has identified and studied 75 mini-hydro projects (generally smaller than 1,000 kW), and constructed a small number.
Generating equipment suppliers have identified at least 40 projects for captive users.

1.7 Previous and Ongoing Development Efforts

In the past, numerous efforts have been made by both the Indonesian government and cooperatives to generate electricity using small-scale hydropower technologies, but the results are still minimal. The Department of Public Works, Directorate General for Water Resources Development, has been including micro-hydro in its projects for a number of years, whenever flow and head conditions are favorable. Unfortunately, these limited attempts to exploit

Indonesia's vast hydropower potential have almost come to a complete halt, after the rural development programs had to be suspended in the face of the country's severe economic and financial crisis.

1.8 Models for Hydropower Development
Three models for hydropower development: captive power plants, small plants that sell power to the PLN grid, and isolated plants operated by community groups for rural electrification. It will broaden the nation's awareness of the benefits of smaller hydro developments, and will mobilize and enhance Indonesian resources so that hydro development becomes a viable, long-term alternative to fossil fuels for electric generation.

2. BARRIERS TO SHP DEVELOPMENT

With its mostly hilly terrains and high precipitations distributed over a large part of the year, Indonesia is blessed with an abundant potential for small-scale hydropower development. Due to various reasons, however, this potential remains still largely untapped. Based on experience gained in previous attempts to exploit this potential, the common barriers to sustainable small-scale hydropower development.

2.1. Structural and policy-related barriers:

Currently, one of the most important common barriers to broader small-scale hydropower development in Indonesia is the tariff structure in the energy sector. The actual electricity retail sales tariffs ¨C which are fixed below production cost and thus are heavily subsidized ¨C make it very difficult to develop hydropower projects on a purely commercial basis in areas that are already reached by the PLN grid. In remote and isolated regions, due to the also subsidized price for diesel fuel, diesel generators often appear economically and financially more attractive than hydropower schemes that normally do not benefit from any subsidies.

Legal, policy, and financial conditions currently are perceived as negative for projects touching on PLN in any way. Information needed to make rational

business decisions in the power sector is often unavailable, due to a lack of transparency regarding procedures at PLN, DGEEU , and Pertamina, the state oil and gas company. Development planning information has been closely held, and detailed financial information (including cost of production in different areas and at specific plants) is unavailable.

There are no standardized procedures and technical codes and standards existing for renewable energy development in general, and for small-scale hydropower development in particular.

Lengthy and not standardized procedures to obtain power purchase agreements, as well as a lack of technical support impede inter-connection of small-scale hydropower schemes with the PLN grid, frequently cause project failure.

Imported equipment for hydropower schemes is expensive, and spare parts are often difficult to obtain. This situation has been accentuated by the monetary crisis and the resulting devaluation of the Indonesian Rupiah, generally disfavoring any imports.

A consistent and transparent government policy supporting renewable energy development is still greatly lacking. As opposed to other rural electrification options, such as grid extension or diesel generators, there are no subsidies, nor any other financial incentives supporting renewable energy development. There is also no target set by the government regarding the share of renewable energy in the country's overall energy mix.

Development plans (such as plans for extension of electric lines into new areas) are not coordinated among PLN, local governments, local residents and cooperatives, other government companies and agencies, and private businesses. Political and outside business motives are often suspected to play a role in development decisions.

There is often a lack of productive end-uses for power in rural areas. As a consequence, load factors of small-scale hydropower schemes often are low, with demand peaking during only a few hours in the evening. The revenues from electricity sales of such schemes often are not sufficient to cover overall production cost.

2.2. Barriers related to technical and institutional capacities:

Stakeholder involvement is often neglected during project selection, planning, and implementation. Active stakeholder participation is especially important for community-based systems, where the stakeholders will be managing and paying for a project upon completion. If stakeholder involvement is neglected, the project acceptance and sense of ownership by the stakeholders is often low, resulting in short project lifetime.

The quality of project selection and evaluation studies is in many cases insufficient.

Pre-investment financial evaluations are often poor quality or are lacking altogether. Many businessmen and other potential developers are not familiar with the advantages and importance of preparing good business plans, as well as cash flow and cost benefit analyses.

Technical problems, resulting from poor design and construction quality (civil, mechanical, and electrical), are common with many small-scale hydropower schemes, and mostly have the same effects as described in the previous paragraph.

Local equipment design and manufacturing capability is limited, and is mostly concentrated on Java.

There are no mechanisms in place (e.g. product liability, quality assurance, technical control institution) that warrant the quality of small-scale hydropower development.

Plant operation and maintenance is often haphazard, with little preventative maintenance. The result are frequent and often long-lasting power outages, which in the case of isolated plants require the customers to possess redundant equipment for lighting, cooking, etc. This hampers the trust in the technology in general, as well as the willingness to pay for the electricity supplied by such schemes.

Project development organizations often have a poor financial record keeping and revenue collection. The consequence is in many cases the inability to recover investment and production cost, leading to poor project performance and hindering replication.

Project owners often lack in managerial and organizational capacities

required to sustainable operate a mini or micro hydropower scheme.

2.3. Barriers related to financing mechanisms

Financing for small-scale hydropower development is unavailable or difficult to locate. Prior to the financial crisis, banks were not lending for hydro or other renewable energy projects, because they were not familiar with the technology, and because the returns did not appear to be as high as for other investments. Currently, Indonesian and international banks are usually not willing or able to lend for any type of project.

Private energy suppliers face higher interest rates than government entities, and will prefer conventional energy options with lower capital costs, shorter payback periods and lower up-front investment cost.

There is a lack of micro-credits for the rural population to purchase electric appliances other than for lighting and thus to invest in productive activities based on electricity end-use.

2.4. Barriers related to awareness and information:

Many institutions and decision-makers are not aware of the possibilities for small-scale hydropower development. The result is often that conventional energy options are preferred, where the potential for hydropower would be promising.

Regional government involvement in development decisions is becoming increasingly important as increased local autonomy is implemented. Up to date, however, there is little understanding of the electric business at that level.

There is no center or network existing that collects and disseminates information on all aspects of small-scale hydropower development. The lack of broadly available information on past experience with hydropower development ¨C for example in the form of lessons learnt and best practices ¨C often results in the repetition of the same mistakes and shortfalls in the efforts to implement projects.

Basic data needed for project evaluation (maps, surveys, hydrology, geology) is often missing or difficult to obtain, especially for more remote regions.

A frequently updated and easily accessible inventory with potential small-scale hydropower sites is currently still inexistent. Potential project developers therefore often have to take a lengthy way through many institutions to identify hydropower investment opportunities. At the same time, attractive sites may remain undeveloped, because they are not known to potential project developers.

The public awareness on the implications of global warming in that every country is responsible to reduce its CO2 emissions and the rapid depletion of the country's fossil fuel resources, as well as the importance of the development of renewable energy resources on the other hand is still greatly lacking.

Many of the barriers mentioned above not only impede small-scale hydropower, but renewable energy development in general.

3. SOLUTIONS:

The barriers to sustainable Small Hydro Power development in Indonesia will be addressed with a number of activities, that are expected to solutions in the following main activities:

3.1 Policy support and energy sector restructuring

Review of existing policy, legislation and regulatory framework in the renewable energy sector in Indonesia, with focus on small-scale hydropower;

Provision of advice to governmental institutions concerned on policy, legislation and regulatory issues that affect renewable energy development in general, and small-scale hydropower development in particular;

Initiation and provision of support to attempts to level the playing field for renewable energy development in general, and small-scale hydropower development in particular, in the course of the restructuring of the Indonesian energy sector;

Development and introduction of technical standards, guide specifications, and guidelines for planning, design, and construction supervision of small-scale hydropower projects;

Design and promotion of the introduction of a standardized power purchase

agreement for the inter-connection of small-scale hydropower schemes with the PLN grid; and

3.2 Technical and institutional capacity building

Development and implementation of special business management training programs for small-scale hydropower project development organizations, owners and operators, to improve their managerial capabilities, especially with respect to financial administration;

Design and implementation of technical training and capacity building programs, covering topics such as project selection, evaluation, planning and designing, construction, operation and maintenance, as well as electrical distribution, metering, and structure wiring to increase the quality and sustainability of small-scale hydropower installations;

Conduct of on-the-job-training of local hydropower equipment designers and manufacturers, to further reduce the dependence of small-scale hydropower developments on equipment imports;

Promotion of the structuring of formal regional "business incubators", where continuing technical and management advice and assistance can be provided to project developers. One target of such incubators would be entrepreneurs interested in forming operation and maintenance (O&M) contractors or project management contractors, which could provide services to several plants located in certain regions. Such organizations could provide a higher level of expertise than would be affordable for single-project O&M and management staffing.

Design and promotion of local, village-based implementation arrangements and organizational mechanisms for effective local participation in developing and operating off-grid hydropower systems;

Design and promotion of the implementation of incentive-based arrangements to encourage good O&M, and revenue collection; and

Formulation and promotion of private/community cost sharing models to be applied at all stages of the development and operation of small-scale hydropower projects;

3.3 Facilitating financing of small hydropower projects

Design and establishment of appropriate and sustainable financing mechanisms for small-scale hydropower projects, based on an analysis of requirements and forms of financial intermediaries available;

Establishment of a special "revolving fund" for small-scale hydropower development for off-grid rural electrification. This revolving fund will grant loans for the implementation of selected hydropower schemes, and will continuously be refilled by the installment payments of the loans. It is clear, however, that as long as Indonesia's energy sector is heavily subsidized, some form of subsidies will also be required for hydropower development to level the playing field with conventional energy options. Different models will be devised and proposed for testing, such as a replenishment of the revolving fund by governmental subsidies that are based on the amount of electricity actually produced by the schemes implemented with loans out of the revolving fund.