Scoping paper

Promoting off-grid renewable energy in Indonesia

Off-grid renewable energy systems, such as micro-hydropower plants, can be the least cost option to provide electricity in rural areas in Indonesia. They can also contribute simultaneously towards Indonesia´s goals for electrification, renewable energy and greenhouse gas mitigation. This paper considers the current Indonesian practice for off-grid programmes and suggests opportunities for improvement. Specifically, it looks for possible synergies between off-grid systems and solutions developed through the MitigationMomentum project for small and medium scale on-grid renewable energy systems; i.e. the types of government intervention that might benefit both off-grid and on-grid systems. Capacity building, technical assistance, and coordination are identified as the primary challenges where such synergies could be achieved. There seems to be limited value to try and address additional challenges around responsibility for ongoing performance and cost recovery, before technical and management challenges are overcome. These issues of operational responsibility and financial sustainability are quite different between off- and on-grid projects, and will need to continue to be addressed for off-grid systems through (coordinated) government programmes and improved provincial oversight and collaboration.

Rural electrification challenge in Indonesia

Almost 20% of the Indonesian population has no access to electricity and, although the electrification rate has increased spectacularly from 8% in 1980, roughly 50 million people still lack electricity for basic needs such as lighting. To address this, the Government of Indonesia (GoI) has set the goal to achieve an electrification rate of 100% in 2020 [ESDM 2014]. In parallel the GoI has set a target of 17% for the share of renewable energy in 2025, with a possible extension to 23% based on provisionally approved draft legislation. Furthermore, Indonesia has pledged to reduce greenhouse gas (GHG) emissions by 26% by 2020 through domestic efforts, or up to 41% with international assistance. These targets are significant in this discussion, because large portions of the population who are reported as having access to electricity, are in fact connected to diesel generators[1], which should be phased out due to their high operational costs, exposure to international oil prices, large public costs in regards to subsidies, and GHG impacts.

[1] Schmidt et al (2013) report that, *"currently, most village grids are powered by diesel plants: at the end of 2007, 936 decentralized diesel power plants (50kW – 500kW) with a total capacity of 987MW were operating in Indonesia (Senoaji 2008)"*.

Deploying local off-grid systems has a long history as a solution to provide power to those without grid access in Indonesia. Much of the population without electricity access lives in rural communities with distant grid access. Indonesia's archipelagic geography, combined with low energy demand in rural areas, makes off-grid power solutions a logical choice to meet demand in these communities in the short to medium term. Renewable energy options such as micro-hydropower and solar PV systems are prime candidates for this, as these resources are readily available throughout Indonesia. Moreover, these options can be attractive from a cost perspective, as their operational costs are generally very low compared to diesel generators. As discussed below, well designed off-grid systems can be the least cost option for providing electricity to a community. Additionally, these technologies fit well in the context of Indonesia´s targets for renewable energy and GHG reductions.

There are many ongoing and historical initiatives from the GoI, non-governmental organisations (NGOs) and international organisations, to build off-grid renewable energy systems in Indonesia. Many of them have successfully provided electricity to communities and improved local livelihoods. In addition several best practice guides have been published to improve chances for successful operation [GIZ 2011; ACE 2013]. However, there are still many stories of off-grid initiatives failing after a limited time, for a variety of reasons.

Salido Kecil mini hydropower plant, West Sumatra

This paper considers the current practice of off-grid renewable energy system development in Indonesia, with special focus on micro-hydropower systems (MHP). It discusses the observed challenges for off-grid projects and proposes avenues for improvement that could be further explored[2], based on an initial survey of literature, together with a number of interviews in the province West Nusa Tenggara (NTB). Ultimately this study aims to contribute to increasing the number of successfully run systems and therewith possibly bringing down the costs for the Indonesian government to achieve its electrification target as well as its renewable energy and GHG mitigation targets.

This paper is a side-track of a broader project that considers on-grid renewable energy generation[3]. Together with the Ministry of Energy and Mineral Resources (ESDM) and Bappenas, that project has identified barriers for small and medium scale renewable energy IPPs (independent power producers) in

[2] As discussed later, robust information on off-grid systems' performance is scarcely available. Nonetheless, from our observations, an overall image emerges that seems sufficiently robust for the current analysis. However one should be aware that individual practice will deviate from the generalised statements on off-grid projects made in this paper.

[3] www.mitigationmomentum.org

Indonesia and prepared a package of policies[4] to try and grow that sector through increased involvement of the financial sector. As on- and off-grid systems share many of the same challenges, this paper explores how that package of policies, developed for on-grid IPPs, could be of benefit to off-grid projects.

Obviously, there are intrinsic differences between on-grid and off-grid projects that could justify different approaches: on-grid is based on a model of private sector investment for profit: IPPs, while off-grid is traditionally funded as a social service, without such a business model. There is no equivalent incentive policy to make it attractive to private sector parties to develop off-grid projects. In spite of this, we ask the questions

- What is needed to grow off-grid renewables?
- Is there an obvious role for the private sector? and
- Are there things that can benefit both on- and off-grid systems?

The paper is based on a combination of a targeted literature survey, interviews with local actors involved in off-grid programmes in the province West Nusa Tenggara and parallel work in the MitigationMomentum project. We start by examining existing government programmes for off-grid renewables in Indonesia to see what can be learnt from these initiatives.

Government programmes for off-grid renewables

Like in many countries, electrification programmes in Indonesia are primarily driven by the state. The largest utility and transmission system operator (PLN) is state owned and is responsible for rolling-out grid access across the various islands. Besides grid-extension, Indonesia has a long history with off-grid electrification programmes, with the GoI running off-grid electrification programmes for several decades. Historically, many such programmes have focused on developing MHP projects, although recently, other technologies such as solar PV are also getting attention.

Programmes developing off-grid systems are run by several GoI ministries, for a variety of purposes. First, ESDM runs an off-grid programme called 'independent energy village' (DME; *Desa Mandiri Energi*) primarily aimed at improving energy access, and a separate programme specifically aimed to promote the production of new and renewable energy (under the responsibility of the New and Renewable Energy directorate of ESDM; henceforth 'EBTKE' programme). Second, the Ministry of Home Affairs (KDN; *Kementerian Dalam Negeri*) runs a programme to promote community empowerment and poverty alleviation (PNPM). Third, the Ministry of Small and Medium Enterprises (SMEs) and Cooperatives (KUKM; *Koperasi dan Usaha Kecil dan Menengah*) runs a programme to facilitate the formation of communal cooperatives, which includes the formation of energy cooperatives. Several of

[4] The policy package is intended to be submitted to the UNFCCC NAMA registry as a Nationally Appropriate Mitigation Action

these government programmes are supported by international organizations such as the EnDev programme operated by GIZ or the Worldbank[5] [GIZ 2011].

There is a wide variation in these schemes in terms of organization, financing and execution. Also, the technological focus may differ. This paper focuses on MHP systems, as most information is available on these programmes; however, this section also briefly touches upon the programmes for other technologies, as this provides insight into their general organization.

The DME programme deploys MHP plants for electricity in village grids as well as biogas facilities to produce gas for heating water and cooking while EBTKE mainly focuses on deploying village PV systems. In both cases, the programmes are organized in a largely top-down structure. This means that the central government ultimately decides what should be deployed and where, and then commissions and pays for the installation. In these cases, there can be limited interaction with the local community to assess needs or preferences prior to commissioning. Obviously, for the DME MHP and biogas systems, some local assessment of resources is required. However, EBTKE often deploys a 'standard solution´ that entails a 15kW PV system with battery back-up. After installation, the system is usually handed over to the community, who then set up a local management and operational team. Management, operation and maintenance are supposed to be paid from the revenues of electricity supply. Managing and operational personnel may receive limited training.

PNPM and KUKM both have a wider focus that is not limited to energy access, but includes this goal. For example, KUKM had a specific target to create 15 RE cooperatives in 2013, throughout Indonesia. These programmes are both organized in a bottom-up fashion, where communities can apply for grants to improve local livelihoods (PNPM) or to assist in setting up a cooperative (KUKM). The communities first prioritize their own needs and preferences, and the ministries then decide which requests have the highest priority to grant funding. In principle the programmes cater to all kinds of requests, and are therefore not focused on any specific technology. Both programmes however are known to fund the development of off-grid MHP systems. Apart from the fact that project proposals in both programmes are initiated in the community, often the community is also more involved in construction activities compared to the centrally initiated projects. PNPM reportedly has an upper limit of 350 million IDR (approximately 30k USD) contribution per project; however, realizing a MHP plant and village grid for this amount is challenging and requires locals to do much of the construction work rather than hiring 'external' professionals. Worldbank [2012] and EnDev [2012] report average capital costs of 500-700 million IDR per system, up to double the available grant.

While the above presents the key characteristics of the main government programmes that are currently operational, it is also informative to examine the results and ongoing challenges to the sector.

[5] EnDev provides, amongst others, technical support in the pre-construction phase on project level for a number of MHP projects in Indonesia (http://www.endev-indonesia.or.id/). World Bank supports PNPM and its predecessor programs through a combination of loans and technical assistance (http://www.worldbank.org/id/pnpm).

Performance of off-grid programmes in practice

Reporting for off-grid programmes is fragmented and incomplete, which makes it difficult to make general claims about performance. A comprehensive country-wide overview of the off-grid sector is non-existent to the best of the authors' knowledge. Much of the available information is therefore anecdotal, or based on limited cases. Generally, programme level reporting is based on those selected projects that have data available, which introduces the risk of selection bias. All in all, this makes it difficult to estimate which of the available data may be generalized to an entire programme, let alone the country as a whole.

The recent performance surveys by EnDev Indonesia [2012] and WorldBank [2012] provide valuable performance data on the MHP projects for which they provided technical support. They present a wide range in performance between different off-grid MHPs in Indonesia. Some installations are reported to run very well, while others are struggling or broken down altogether. This corresponds well with the authors' general impression from practitioners, that the majority of off-grid MHP installations in NTB were non-operational.

From these reports and other sources, a number of challenges may be identified with regard to the functioning of off-grid MHP installations. Challenges are grouped here according to three main aspects: i) institutional arrangements, ii) costs and management, and iii) operations and maintenance. The subsections below look into each of these challenges in more detail. If these difficulties are not overcome by a project, revenues are typically insufficient to pay for operational expenses, regular maintenance, necessary repairs or spare parts, ultimately leading to discontinuation of electricity supply. Less dramatic situations also occur, in which the installation functions sub-optimally, for example delivering low electrical output. The subsections draw heavily from the performance surveys by EnDev and Worldbank, and focus on those aspects that are most relevant to this paper – i.e. looking for common solutions to on- and off-grid renewable energy barriers – and do not attempt to be exhaustive. Where relevant, observed practices for off-grid MHPs are compared with those observed for on-grid IPPs.

Institutional arrangements

A number of aspects of the institutional arrangement of MHP development in Indonesia arguably lead to inefficiencies. The first is that typically, the government pays the full cost of installation, but hands over responsibility of the plant to the local village once it's finished. Due to this arrangement, an effective financial driver for parties to ensure proper performance may be lacking. This is very different in on-grid systems, where market parties (IPPs) put their own capital and borrowed money at risk to ultimately make profit from selling power.

Although a functioning system is generally guaranteed through warranties, the constructing party does not have to bear the consequences of suboptimal design choices for the system. At the same time, the MHP administration that will be responsible during operation, often has only limited control over design choices. Thus a risk for suboptimal design is introduced, which is especially relevant for top-down organized programmes, with limited local involvement. Involving the local community in the initial stages of project deployment is listed as part of best practice for these reasons [GIZ 2011; ACE 2013].

Moreover, the arrangement may lead to the MHP not being appraised at its real value by the community – after all since it was free in the first place, there is perhaps less perceived loss if it breaks down. The top-down implementation strategy, historically dominant in Indonesia, may lead to a loose feeling of ownership and passive attitude towards arising problems. A common expectation sometimes seems to be that it is the government's responsibility to step in when bigger problems arise, for example to provide additional budget for repairs.

Given the above, introduction of stronger market elements, could possibly strengthen the sense of ownership and improve performance of MHP installations, also from an overall financial perspective. Ghosh et al. [2012, in Schmidt et al. 2013] write that "in order to assure efficiency of public spending, redistribution should be paid based on performance of a project instead of solely providing grants for equipment upfront". In theory, under the right conditions, it should be possible for an off-grid system to be run as a business venture similar as an IPP. However, based on the observations made during this study, this kind of approach is unlikely to be implemented in the near future.

Key issues in institutional arrangements

- Split in parties responsible for commissioning (government) vs. operation (local) can result in suboptimal design
- Absence of financial risks for operator can cause loose sense of ownership and limits incentive to optimize performance
- The above two issues may lead to higher than necessary costs of off-grid energy
- Provincial coordination of initiatives and with PLN grid-extension plans offers opportunity for more strategic site-selection
- More exchange of information between off-grid programmes and between projects can offer opportunities for learning for government and operators

Shifting the actual financial responsibility towards a private entity or self-ownership, is often argued to lead to more efficiently run operations. But with the limited financial capacity of consumers in rural communities and the relatively high capital cost for small off-grid systems, a financial contribution from the government would still be indispensable in most situations. Given the primary goal of increasing energy access and the fact that incentive policies are available for on-grid IPPs, incentives for off-grid systems seem easily justified. If the technical performance of installations could be improved (and therewith the expected revenues) the government contribution per project could possibly be brought down. Schmidt et al (2013) argue that if current fuel and electricity subsidies are taken into account, off-grid small scale renewable energy systems can lead to a profitable business case for the government compared to a diesel generator alternative. However, there does not yet seem to be a move towards this sort of model for off-grid development and justification of improved technical quality.

In the case of MHPs run by cooperatives, some market drivers already exist. Members of a cooperative directly profit from higher revenues and have a vested interest in successful operation. Even still, the government generally pays the majority of investment costs and cooperatives run limited risk. Given the need for local involvement and the scale of the investments, well organised local cooperatives or wealthy local businessmen seem to be the most likely candidates to increase private investment in the sector. Attracting external private investors, even if a proposed investment covered a group of several installations together, is substantially more challenging. The topic of external private investment merits further consideration in the longer term, as there are potential risks and ethical issues involved in encouraging rural villages into financial risk-taking in order to get energy access.

As the range in performance between projects is wide, it is better to first understand what works and why. A first step could be to closely monitor the performance of cooperative-run vs. village-run MHPs, to see where possible differences arise. Then, lessons from these observations should be drawn, shared and implemented in the existing schemes in order to test their effectiveness. Only after this proves successful, does it make sense to expand the number of local energy cooperatives.

Lebah Suren micro hydropower plant, Lombok

At the moment, many community operators have very limited possibilities to learn from other schemes. Some schemes are supported NGO's or international initiatives and may encourage peer-learning between projects. However, a larger share of the projects do not have such resources or support. They operate in relative isolation and communicate with other projects infrequently. Furthermore, as limited data is available on the performance of systems a useful benchmark is generally not available. More coordination and peer learning between different schemes during operation could improve technical, and also financial performance, leading to more benefits for the local community.

From our interviews, it is clear that there is not only limited communication and coordination at community level, but also at the programme or ministerial level. As mentioned, there are a multitude of government programmes, but there seems to be limited coordination between the ministries that are responsible for their execution. Government officials at the provincial level seem to have limited overview of which activities take place. In NTB, each of the provincial agencies that were interviewed (Distamben, PNPM, Dinas Koperasi) was involved in a different MHP initiative and no evidence of communication between these initiatives was observed. As a result, the provincial energy authority had incomplete data as to how many off-grid energy installations operate within the province and, similarly, the Department of Cooperatives had incomplete information on how many energy cooperatives exist. The activities are apparently only registered locally, at the sub-provincial or regency level. This is likely to be one main reason why little aggregated information on MHP performance seems to be available. This lack data and coordination is detrimental for learning also between ministries and for improving the current approach to off-grid renewables.

Lastly, the programmes seems to take limited account of grid developments. Interviewees noted several occasions where off-grid projects were developed in an area that was soon going to be, or already had been, connected to the PLN grid. As PLN connection is often cheaper, as well as more reliable than a village grid, villagers will usually choose a PLN connection over the village MHP. As PLN is running major grid-extension programmes, off-grid initiatives should anticipate these developments. Especially in the situation where grid access may be arriving within the expected lifetime of the MHP system, it would be beneficial to select a system with technical specifications that could be connected to the grid.

Costs and management

As noted earlier, construction costs of off-grid systems are often fully paid by central or local government, or international development organizations, especially in top-down programmes. Communities in the green PNPM programme do contribute in-kind in many schemes; and in some cases communities are reported to have contributed between 5 and 10% in cash [Worldbank 2012]. KUKM also indicated in interviews that cooperatives sometimes also pay a small share of the equity in their projects. The implications of negligible levels of local ownership in a project have been discussed in the previous section.

Key issues for cost and management

- Low capacity factors contribute to high costs of electricity for off-grid installations
- Consumer tariffs designed to cover operational expenses may not cover repairs or other issues
- Tariffs are ultimately unsustainable as they do not cover full costs of electricity; revision will require government incentives
- Mismanagement sometimes leads to insufficient savings or savings being spent for non-intended purposes

In terms of delivered energy costs, EnDev [2012] state that average levelised cost of electricity in their survey is 22k IDR/kWh (approximately 2 USD/kWh). When compared to an average of 1.2k IDR/kWh for on-grid production by PLN, or even 3.2k IDR/kWh for average diesel generation [PLN, 2012], off-grid MHPs are clearly more expensive. The first main reason for this is that the costs for off-grid village systems include the costs of the local distribution infrastructure, so in some sense the above costs are not directly comparable. Second, small-scale systems, of the type used for off-grid applications, are generally more expensive per kW than larger ones. Third, many systems have very low reported capacity factors[6], which increases costs per kWh as the systems are producing comparatively low amounts of electricity. Even so, there are good reasons to construct off-grid MHPs in remote areas. First, and foremost, they can provide energy access to communities that lack this basic service. Second, off-grid MHPs can still be a least cost solution in many situations, given that grid-connection points are not always closely available and that grid extension costs can be a significant element when making a fair comparison. Moreover, improved performance, design and O&M practices have the potential to substantially reduce the costs. EnDev reports that if the capacity factor for installations in their survey would be brought up to 50%, the average LCOE would drop to 1400 IDR/kWh, which would be in line with international observations [ClimateTechWiki 2013]. Moreover, Blum et al. [2013] calculate that off-

[6] The ratio of a power plant's actual output over a period of time, to its potential output if it were possible for it to operate at full nameplate capacity. A lower capacity factor means that, on average, the plant is producing less power than it theoretically could.

grid renewable systems may well be competitive compared to diesel generated electricity if subsidies and fuel transport costs are taken into account.

Off-grid MHPs are usually managed by a small team of local administrators. The MHP can be organized as a cooperative (*koperasi*), however, in many cases no clear legal form is apparent. For cooperatives, (as promoted by the KUKM programme), consumers are often also members, so have a formal say in how the MHP is run. In other cases, the administration is appointed by the village heads and villagers only have an indirect say. There does not seem to be much difference in the types of financial scheme used to administer off-grid MHP between cooperative and village run systems, even though a cooperative should theoretically be profit driven, with members dividing revenues, whereas no such market element exists in village run systems.

Different payment models do exist though; with variations including that consumers pay a flat fee only, a flat fee plus price per kWh, or a flat fee plus a progressive price per kWh, so that the poorest villagers (with lowest consumption) may also afford energy access. There appear to be few rules for tariff schemes; administers can decide the tariff structure for their own scheme. If the full costs of production would be passed on to the consumers, an unequal situation would exist compared to normal grid-connected consumers, particularly given the ability to pay of many rural communities. With (most of) the construction costs paid by government, tariffs for consumers can be kept at acceptable rates, as these only have to compensate management fees and operational costs.

From interviews, GIZ report that on average, a monthly revenue of 25k-30k IDR per household should suffice to pay for regular operation and maintenance. However, it is unclear whether most payment schemes generate sufficient revenues. Some practitioners are generally positive about this, whereas others claim that many schemes are unable to set aside sufficient savings to allow for more significant maintenance events. Anecdotal evidence suggest that saving rates are often set too low to hold sufficient capital for repairs, or that accrued savings are spent for non-MHP purposes, especially in village run systems. The fact that comprehensive data on this is missing, combined with the incidental stories about poor management, warrants further attention to management schemes and guidelines.

The financial management for off-grid systems shows a very different picture to on-grid systems, with different sources of investment capital as well as different approaches for revenue handling. On-grid there is a fundamental financial incentive to make sure the MHP is operational, in order to get revenue to pay off project debts and provide a return to the investor(s). That driver of performance is not there for the majority of off-grid projects or much more weakly formed. This suggests that different or additional approaches to improving off-grid performance and management will be needed as compared to on-grid systems.

Operation and maintenance

A common complaint for off-grid installations is that O&M skills and practices are insufficient to maintain operation. It is important to realise that MHP plants are complex pieces of equipment, dissimilar to infrastructure that would have been present in the area before, and which require expert knowledge to design and operate. Good technical performance of an installation starts with proper technical scoping before construction and operation. Just as for grid-connected systems, before construction, a feasibility study should identify the existing hydrological potential, expected demand, expected tariffs, technical characteristics of the intended installation, and then assess investment cost. This process requires a high level of technical expertise, which must typically be acquired through specialised consultants. In the barrier-analysis for on-grid small and medium scale renewables, acquiring the right level expertise in this initial phase has been identified as a challenge in Indonesia [MitigationMomentum 2014]. Out observations suggest that limited technical expertise is also an issue for off-grid MHPs.

Many MHPs are reported to operate well [EnDev 2012 and Worldbank 2012]. Nonetheless EnDev reports that 1/6th of the sites were non-operational due to breakdown at the time of survey, and that more than half of the sites reported to have experienced at least one breakdown in the year 2012. It is not known whether installations outside their samples operate at a similar or lower performance level.

Key issues for operation and maintenance

- Limited availability of technical expertise leads to mismatches between hydro resources, installed capacity and electricity demand, resulting in low capacity factors
- Off-grid programmes offer limited training opportunities for plant operators
- High number of breakdowns reported, possibly linked to the limited technical capacity of operators or design issues

Moreover, both studies report very low average capacity factors, for example EnDev reports an average capacity factor of only 11%[7]. The reason for this is often due to poor design of the system versus the available water resource; WorldBank [2012] reports a "mismatch of design and actual water flow capacity resulting in under delivery of power output". Restating this, the generation equipment that is installed in these locations is often too large for the available resource, which also inflates the capital costs.

Another reason for the low capacity factor is often a mismatch between design capacity and local energy demand. Put simply, the power plant produces more power than is needed and hence is not operated at full capacity or as often as possible. This is visible in the observed difference between expected and realized number of connected households in both surveys. EnDev suggests that this may be partly due to the early operational status of some of the sites, and that the number of households increases over time. However, it seems also that the demand assessment in the scoping phase has not been optimal, as for multiple reasons, less households are connecting; the Worldbank survey reports a mismatch of 50% less connections per kW installed capacity. A striking example in the EnDev survey is that 26% of the 'missing connections' are due to the fact that these connections are connected to the PLN grid in the meantime. This could be an indication of a lack of coordination between initiatives and PLN extension plans. After all, if a PLN grid-connection is planned, one may question the rationale for constructing a separate village grid with MHP. Moreover, in such a case one might want to alter the design of the MHP so that it could also get connected to the grid – and its production capacity becomes independent of local demand.

[7] i.e. the systems only provided 11% of their rated generation capacity over the year, which is very low. Larger mini-hydro systems might aim for capacity factors in the order of 60%, for example.

Issues of lower capacity factors and low electricity production are also commonly seen in on-grid facilities, particularly in regards to the accuracy of the initial design. For example, Muchtar et al. [2014] also calculate low capacity factors for a number of grid-connected MHPs run by IPPS in West Nusa Tenggara, which appear to be caused by faulty calculations in their feasibility studies. This shows the need to improve design and resource estimation capacity amongst both communities of practitioners; on- and off-grid.

For off-grid systems, technical requirements form additional challenges during operation. Grid connected IPPs, operating at a significantly larger scale and with, presumably, more in-house expertise, already face difficulties to identify sufficiently qualified O&M personnel. Off-grid systems are largely dependent on the available skills of locals, as it is rarely economically feasible to attract someone from further away specifically for the job. The level of technical skills needed for operation of these plants is not normally found in local communities. Although technicians may receive a short training on operating a MHP plant as part of a government or international support programme, it is generally considered insufficient by interviewees. Unskilled handling may result in suboptimal maintenance or operation, in turn resulting in more downtime and quicker deterioration of the system.

Operation and maintenance of off-grid systems faces additional challenges due to restrictions from available budget as discussed above. Revenues from off-grid systems are generally limited, given their small service area and low capacity factor. Even though some savings generally exist, this makes the system relatively vulnerable for costly incidents, such as landslides destroying part of the infrastructure, or the necessary replacement of expensive components.

Conclusions

In this scoping paper, technical and project management capacity is identified as the leading challenge for off-grid renewable energy installations. It impacts on the performance of projects through design inconsistencies and it impacts ongoing operation through suboptimal maintenance. This, in turn, impacts the viability of projects in terms of increased costs, ultimately resulting in less results for the available budget.

In regards to on-grid renewables, the MitigationMomentum project has previously identified similar challenges for attracting private finance for small and medium scale renewable energy IPPs. To overcome these challenges, a package of policies (NAMA) has been drafted that, amongst others, proposes the formation of a Clearing House for IPPs (CHIPP) [MitigationMomentum 2014]. This CHIPP would serve as a technical knowledge and assistance centre that could: monitor the development of on-grid RE-IPPs; assist in the design of feasibility studies through guidance and financial support; facilitate a network of technical experts; and connect people that could benefit from each other's experiences.

The results of this study suggest that there could be significant value in providing a similar support centre for off-grid MHPs. In addition to the tasks above, it could track system performance and compare with benchmarks to identify possibilities for improvement. It could also liaise operators with experts or each other for learning and improving performance. Given the suggested role for the CHIPP, it could be possible to extend such the proposed organisation's scope to cover off-grid renewables. At the same time, there is an existing Association of Southeast Asian Nations (ASEAN) MHP centre in Bandung[8] with a focus on training and knowledge exchange. Extending the role of this existing organisation or linking it through the CHIPP to reach a wider audience within Indonesia should also be considered. Any support centre should also aim to learn from and cooperate with organizations that have already started valuable initiatives to keep track of affairs (such as the GIZ monitoring and evaluation programme[9]).

Although several challenges have been identified in the arrangement of the cost sharing and revenue structure in off-grid projects, there is arguably limited value in focusing on these before technical and management challenges are addressed. Partially shifting investment costs to the party responsible for operation may provide more incentive for improving performance through appropriate plant design and maintenance practices. However, it seems unwise to shift financial risks to rural communities without first equipping them with proper means to address them. In keeping with the GoI's and PLN's approach, rural electrification is primarily a government responsibility.

Additional efficiency gains for off-grid programmes may be achieved through greater coordination between the various off-grid programmes from different ministries. Particularly officials at the provincial and regional levels, who execute programmes, could learn from each other's experiences. Although each of the ministries has different aims and responsibilities, it seems inefficient to have four different government programmes with overlapping mandates to establish off-grid MHPs. One could consider combining the execution of the programmes at the province level, to avoid a situation where each provincial ministry is involved in a different programme.

In summary, there seem to be opportunities for the solutions to on-grid development challenges to impact off-grid projects. Most concretely they exist in terms of capacity building, technical assistance and coordination. Other substantial challenges, around accountability and cost recovery/revenues, show important differences to on-grid projects and will need to continue to be addressed through (coordinated) government programmes and improved provincial oversight and collaboration.

[8] www.hycom.info

[9] EnDev has started a monitoring and evaluation programme for its projects in 2012, which now leads to an increasing amount of longitudinal data, that could be a very valuable source to identify structural bottlenecks and need for possible interventions

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CDKN Climate & Development Knowledge Network

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