PACEAA

Poverty Alleviation through Cleaner Energy from Agro-industries in Africa

Facilitating the involvement of agro-industries in rural electrification

Project summary report

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Background

It is universally recognised that providing poor people with access to modern energy services can transform their lives and help them break out of the vicious circle of poverty. In spite of this, some 1.6 billion people around the world are still 'off-grid', lacking access to electricity supplies. The great majority of them live in rural areas and are facing poverty, and nowhere is this more so than in rural Africa. Here, where conventional grid extension meets its economic and technical limits, large proportions of the population remain dependent on traditional biomass for their basic needs, have no lighting for health centres or schools and can only dream of motive power that could substitute for the human energy they expend in their agricultural and other activities.

Providing modern forms of energy to so many using conventional fossil-fuel -based solutions would mean increased consumption of dwindling natural resources and more greenhouse gas (GHG) emissions at precisely the moment when there is a need for conservation and reduced emissions. For some developing countries, and this is notably the case in Africa, greater use of conventional sources would also mean greater reliance on costly imports, which is already damaging their balance of payments, as well as greater insecurity of supply.

The sheer scale and complexity of the problems of rural electrification suggest strongly that there is a need for a different pattern of development, one that seeks to provide poor rural populations with energy that is both affordable and sustainable. This was the starting point for the Poverty Alleviation through Clean Energy from Agro-Industries in Africa (PACEAA) programme, a project coordinated by UNEP-RISOE and its French partner Innovation Energie-Développment (IED – an independent engineering and consulting firm). Box 1 provides a summary of the project's organisational background.

The PACEAA concept is straightforward. Agro-industries are the mainstay of many growing economies and—since they are based in rural areas where grid electricity supply is often unavailable, inadequate or unreliable—they have a vital interest in finding alternative supplies that are less costly and less polluting than the diesel generators to which they often resort. As a result, companies have shown increasing interest in generating their own power from renewable sources such as small-scale hydro plants, use of combustible waste materials for cogeneration (notably 'bagasse' in the sugar industry) and other renewable sources.

But what about the residents in those rural areas, is there some way they could benefit from surplus energy produced by companies for their own needs? PACEAA's proposal is that with the right planning and project structure they can.

In fact, a number of countries across the globe have had pioneering experiences that are relevant to this type of electrification project, mainly in South-East Asia and Latin America. The earliest efforts to provide electricity to remote locations date from the 1990s when the pioneering nations focused on small-scale hydropower (SHP) to cater for specific loads belonging to agricultural facilities, rural industries and individuals. These sources were later used to supply power to groups of rural consumers in places where grid-based electrification was unattainable and when escalating fossil fuel prices triggered the decline of the ubiquitous diesel generator.

The latter part of the 20th century also saw a wave of energy sector reforms with countries embracing decentralisation of their power systems and use of renewable energy sources that are in plentiful supply in rural areas. Concurrently, as governments relinquished some aspects of their role in rural electrification responsibility devolved to sub-national and private actors, and NGOs and other community development facilitators entered the field, the latter actively promoting community based electrification. It is in this context that the involvement of agro-industries in rural electrification is considered for the PACEAA project.

Box 1:

PACEAA
– background and coordination with other projects

With support from the European Commission's (EC) COOPENER programme UNEP-Risoe's PACEAA project is helping to develop tools, policies and business infrastructure to make affordable and sustainable electricity available to rural populations.

An organisational first

The start of the three-year PACEAA programme was timed so that it would run alongside and be coordinated with two larger Global Environment Facility (GEF) initiatives: Greening the Tea Industry in East Africa (GTIEA), executed by the East Africa Tea Trade Association (EATTA); and Cogen for Africa, executed by AFREPREN/FWD. This three-project complex is the first time that an EC project has been coordinated and co-financed with GEF.

Focus of the projects

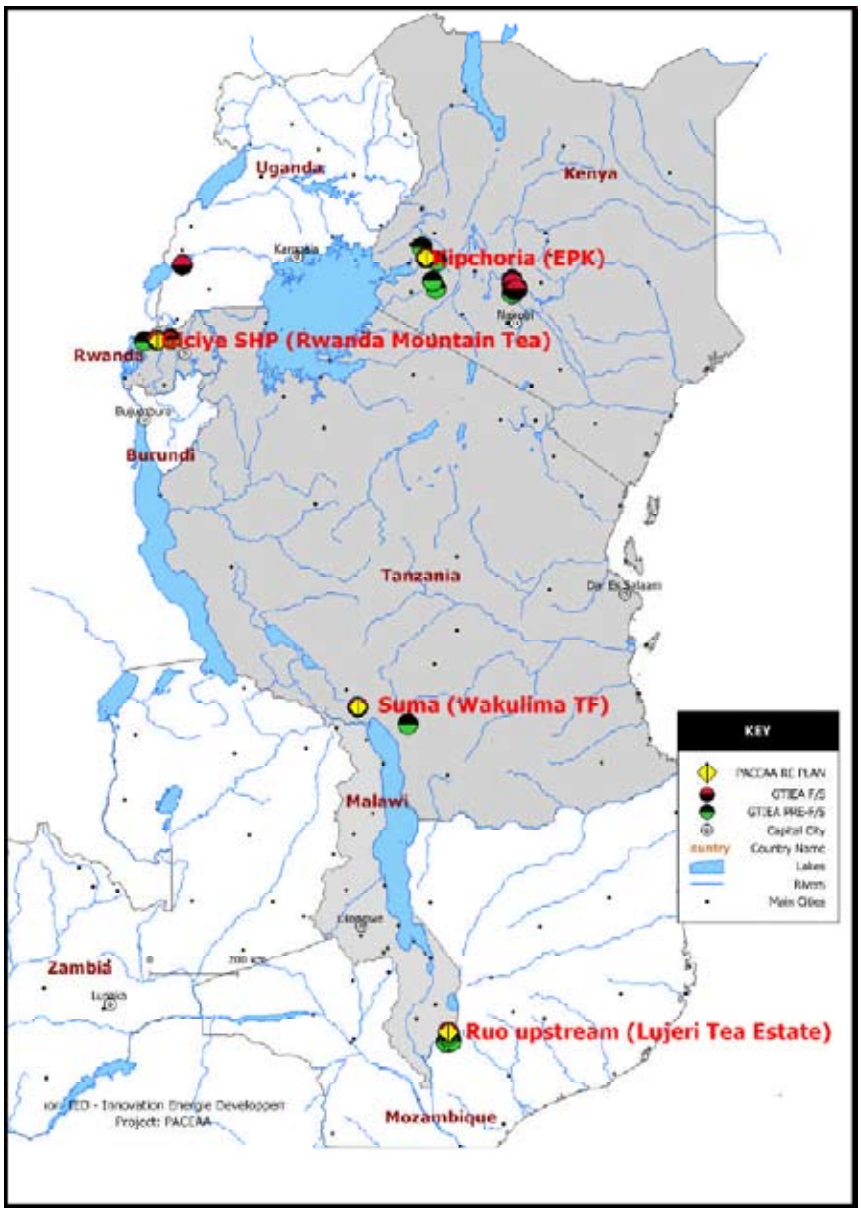
The two GEF projects are primarily concerned with the generation of clean, stable electricity for rural agro-industries. GTIEA focuses on the potential for the tea industry to develop small-scale hydropower to supply its processing factories with electricity as a substitute for expensive and unreliable power from grids or polluting and expensive back-up diesel generators. Cogen for Africa is helping to transform the market for cogeneration in Eastern and Southern Africa, by strengthening the capacity of cogeneration project developers, technical service providers and local manufacturers to deliver profitable cogeneration projects, principally from sugar cane bagasse.

PACEAA has a different focus: the aim is to build a framework to support a system where surplus hydropower over and above factories' needs could be used to serve local communities. The project is designed to help remove policy, commercial and regulatory barriers to use of this energy by local populations and to propose financial incentives that encourage the involvement of agro-industries and other stakeholders in rural electrification using clean energy.

For full details, visit: www.paceaa.org

The PACEAA programme concentrated on small hydroelectric projects in East-African tea growing regions, but the concept can be applied to many other types of renewable energy projects. In fact, one of PACEAA's main aims was to create a replicable process that could be easily transposed to developing countries. Around the world, many agro-industries such as floriculture, horticulture, dairy farms and sugar processing are investing in renewable energy projects that include biogas or cogeneration using agricultural waste. The generation methods vary but the basic concept remains applicable: surplus energy could be used to bring electricity to

Map 1.



rural villages to advance development goals and improve quality of life. This summary report therefore attempts to describe PACEAA in some detail but also maintains a firm focus on those aspects of the project that could be transposed to other situations. Accordingly, it looks at methods for selecting targets for electrification that will ensure optimum benefits from the power provided; appropriate business models and, more specifically, how to select the most suitable model for a given country situation; it then considers what is needed to create an enabling environment for stakeholders participating in PACEAA and similar projects.

Getting down to details – a closer look at PACEAA

PACEAA is a robust and straightforward concept, but achieving its goal of formulating replicable and ready-for-implementation packages covering institutional, financial and technical issues meant analysing a complex situation involving stakeholders with very different backgrounds and aims. This required developing an understanding of the energy needs and priorities of the industries that would supply the energy; clear identification of the beneficiaries of the project; identification of policy, commercial and regulatory barriers that may be restricting uptake of renewable energy from agro-industries; and then identification of best practice solutions to address barriers and needs.

PACEAA's initial investigations covered 11 African countries (Burundi, Ethiopia, Kenya, Malawi, Mozambique, Rwanda, Sudan, Swaziland, Tanzania, Uganda, Zambia) where demand for power in rural areas is high (the average rural electrification rate for these countries is not more than 5 per cent). Based on the results of pre-feasibility studies carried out by IED, four countries (Kenya, Malawi, Rwanda and Tanzania) were selected for development of rural electrification business plans and for more in-depth policy review (see map 1). Box 2 gives an outline of these four pilot sites, which are the main focus of the PACEAA project and form the core source of information for this summary. Although PACEAA originally intended to cover the provision of power for rural electrification from small hydro sources and from cogeneration facilities set up by agro-industries, it was found that the industries using cogeneration were more intent on selling the excess power to their national grids.

Box 2:

Pilot studies – Outline

Four pilot sites were selected on the basis of pre-feasibility studies carried out by IED. These are sites that have a potential for development of small hydropower schemes that would benefit both the tea factories and the surrounding communities.

Kenya: Kipchoria, Nandi Hills

The project area is located in the Nandi Hills, in the west of the Rift Valley.

Eastern Produce Kenya (EPK) plans to invest in the proposed Kipchoria SHP site, rated at 2 850 kW, to connect four tea factories. Excess hydropower would be injected into the KPLC (national utility company) grid at the regulated feed-in tariff, and/or it could be used for the proposed PACEAA rural electrification.

Most unelectrified settlements in the area are located close the KPLC grid, except for the most remote villages. These are the areas targeted by the PACEAA rural electrification plan. Settlements in Kenya tend to be dispersed: a trading centre will, at the most, have a few shops, a church, and a school. The majority of households lie outside of the trading centres; the focus of the electrification project is therefore non domestic uses of electricity. Some estate workers camps may also be electrified by EPK, as a separate project, mostly for domestic lighting purposes

Malawi: Lujeri tea estate

The Project area lies at the foot of the Mulanje Mountain. The Lujeri tea estates are located at the centre of a valley, while potential candidate villages for rural electrification, with very high population density, are located between the tea estates and the mountain slopes.

The hydro scheme selected and identified for feasibility study was the Ruo upstream project (upgrade of the current scheme), located on the Ruo river in the northern part of the study area. The project is, however, currently postponed, since it would require an 18 month shutdown for Lujeri tea factory. The rural electrification plan was developed nonetheless, on the assumption that the rural communities identified could benefit from hydro power in the future, either from this project or similar medium term alternatives.

If additional hydro capacity is added to satisfy all tea factory demand in the rainy season, around 22 per cent of hydro output during dry season, i.e. about 1,800 MWh/year, would theoretically be available for other uses such as rural electrification. This would be sufficient to cover roughly 50 per cent of rural demand in the dry season. The rest would have to be provided by the utility.

Rwanda: Giciye SHP

The project area lies in the north-western part of Rwanda, in the Nyabihu and Ngororero districts.

The Rwanda Mountain Tea (RMT) company plans to invest in a small (4.5 MW) hydro scheme on the Giciye river.

Power would be injected into the nearby grid and sold to RECO (national utility) at an agreed feed-in tariff. A wheeling agreement will be negotiated to ensure that the tea factories benefit from the cheaper hydropower.

The project is already having positive side-effects on electricity access in the area as RMT has already committed to building line to a health centre and nearby town. In addition to this, under the PACEAA project tea-growing communities close to the tea factories and to the proposed SHP scheme should also benefit from the proposed rural electrification plan, hopefully benefiting from the wheeling agreement as well.

Tanzania: the Suma hydro scheme

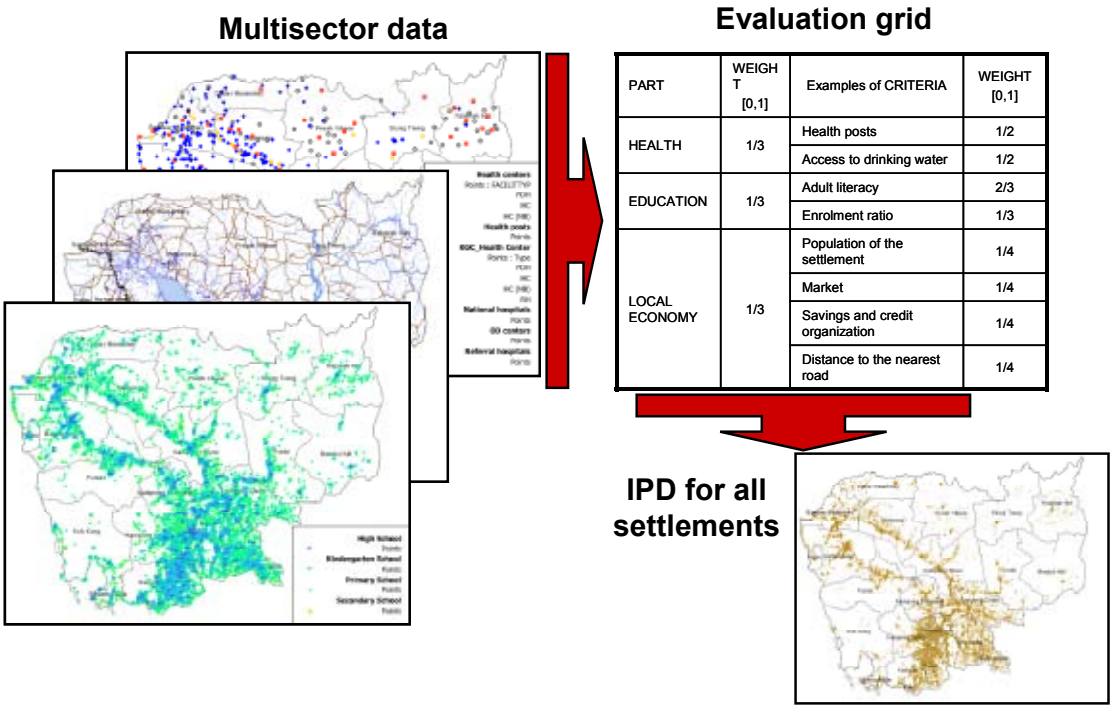
The project area falls in Rungwe district in Mbeya region (South-Western part of Tanzania). The study area is defined by the Katumba Tea Factory to the west, the Mwakaleli Tea Factory to the east and the proposed small hydro power plant to the south of the town Suma. The Wakulima Tea Company plans to invest either directly or through a SPV into the Suma hydro scheme on Suma river, evaluated at about 1.5 MW. A direct line would be built to supply Katumba tea factory and inject the surplus to the TANESCO grid, at the regulated feed-in tariff. The TANESCO grid already covers some of the main towns of the area, such as Suma town, along the main road from Katumba to Mwakaleli tea factory and Kendete town. The level of electrification in these places is very low, and support is needed to help pay the upfront connection costs. Most villages inland from this main road are relatively scattered, making rural electrification projects appear less attractive. However, a few centres are still suggested as targets for electrification from the suggested Suma SHP and the power line going to Katumba tea factory.

Developing the Rural Electrification Plans

The first step in the orthodox methodology for design of an electrification project is to take a close look at what is being proposed and to verify that it is financially and technically feasible. However, for PACEAA, with its focus on poverty alleviation, the initial step was to anticipate the impact that the proposed rural electrification project would have on social and economic development of the places targeted for electrification. In other words, cost per kilowatt-hour and numbers of connections achieved were not the only criteria underlying the rural electrification plan. For PACEAA, 'load centres' (i.e. places to be electrified) were first identified, based on local knowledge and field surveys, and a multi-criteria analysis was then performed to rank them according to the expected benefits that electrification would have both on the load centre itself and on the surrounding communities (e.g. through better health and educational services and amenities).

A methodology for identifying load centres and a ranking index developed for PACEAA

The method used to rank load centres according to their expected potential on local development (illustrated in Figure 1) draws its inspiration from the Human Development Index (HDI) developed by the UNDP. For PACEAA, the Indicator for Potential Development (IPD), a composite index similar to the HDI, was calculated for each load centre, using survey data on social and economic facilities. The IPD ranges from 0 (no potential for development) to 1 (highest potential).



PART	WEIGHT [0,1]	Examples of CRITERIA	WEIGHT [0,1]
HEALTH	1/3	Health posts	1/2
		Access to drinking water	1/2
EDUCATION	1/3	Adult literacy	2/3
		Enrolment ratio	1/3
LOCAL ECONOMY	1/3	Population of the settlement	1/4
		Market	1/4
		Savings and credit organization	1/4
		Distance to the nearest road	1/4

Figure 1: the IPD calculation process (example from Cambodia at national level)

The evaluation matrix for the IPD has the same three main components (health, education and economy) as the HDI evaluation matrix. These components are subdivided into criteria and the score for each component is calculated from a weighted set of criteria (i.e. not all criteria will have the same importance in the final result). The score for each criterion is itself defined by indicators (for instance, the score for 'access to healthcare' can be defined by the 'type of best hospital in the settlement'). The criteria and their weights and indicators must be established and accepted by the different stakeholders.

Figure 2: components of IPD

Ultimately, **villages with the highest IPD scores will be those, which already have decent community and economic services**. Giving higher electrification priority to such places ensures that local communities reap the short-term benefits of the project. But electricity, of course, also brings new services and income generating opportunities over time and this too is taken into account when producing the load forecast, as explained below.

Technical aspects: forecasting future loads

Once the load centres have been identified, the next objective is to characterise them from the electrical point of view: in other words, how much would the tea factories and rural electrification load centres consume over the 20-year planning period?

To attempt to answer this question, the following outputs were generated for each load centre:

- numbers of single-phase and three-phase clients;
- peak power demand;
- yearly consumption;
- average daily load curves.

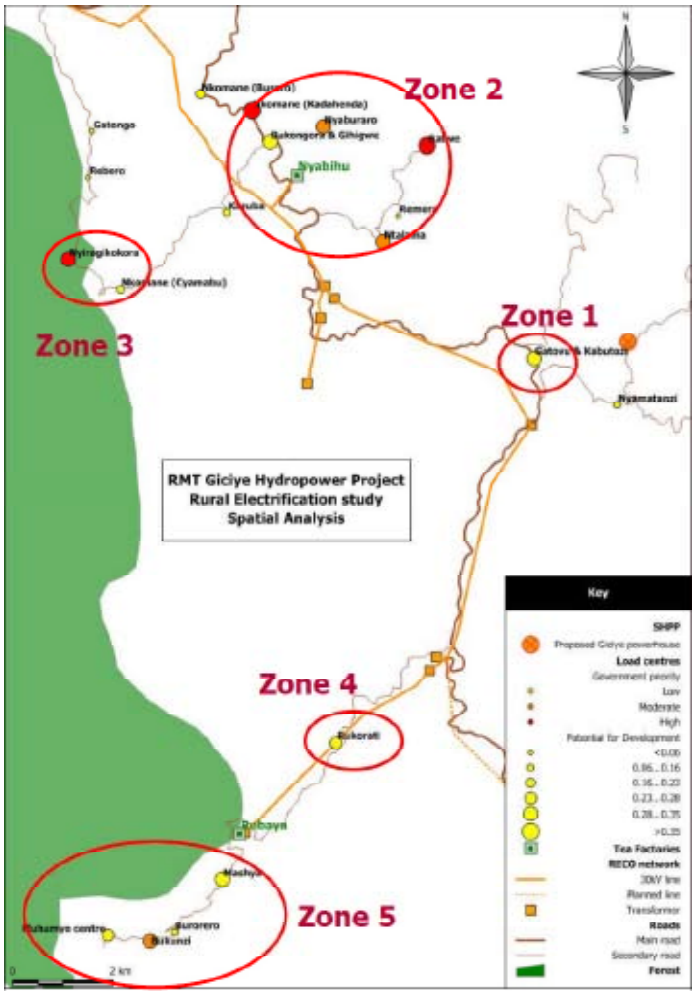
The approach used for PACEAA belongs to the 'bottom-up' family of load forecasting models. Based on information from field mission surveys, questionnaires and other methods, consumption profiles are drawn up for each of several different types of end users (e.g. households, schools, shops, other productive activities etc.) and demand is calculated from the profiles. Estimated population growth rates and technical distribution losses are taken into account and it is also assumed that, while the number of social and community amenities (schools, health centres and churches) will stay constant over time, the number of commercial activities will grow after electrification. A summary example (from Malawi) of the results of the forecasting exercise is shown in Table 1. More detailed load curves per type of user were also produced.

Table 1: assumptions for specific consumption for different types of end users, Malawi

	Appliances	Installed capacity (W)	Consumption (kWh/month)
HH (class 1)	5 lighting points, 1 TV, 1 radio, mostly evening	298	40
HH (class 2)	3 lighting points, 1 radio, mostly evening	138	20
HH (class 3)	2 lighting points, 1 radio, mostly evening	98	12
Water pump (per 100 hh)		500	91
Street lighting (per 100 hh)		250	53
School	10x25W lighting, evening (CFLs)	250	23
Dispensary	150 W all the time (refrigeration, nominal capacity 450 W, 5x25 W lighting morning and evening (CFLs),	275	132
Church	2x25W lighting morning and evening (CFLs) and sound system (200W)	250	38
Shop	50 W all the time (refrigeration, nominal capacity 150 W), 1x25 W lighting morning and evening (CFL)	75	43
Barber, video show, arts and crafts	on average 300 W during the day	300	62
Carpenter, welding, battery charging	Installed capacity of 1.5 kW, operating morning and afternoon	1,500	224
Mill	Average 15 kW	15,000	1,049

Supply is available, but does it match demand?

The next step was to compare the estimated loads with the power that could be made available from the projected hydro schemes. In all of the four pilot studies it was estimated that the demand from rural electrification would represent a negligible proportion of hydropower output. This is illustrated by figures 3 and 4, from the Kenyan case study, where usage of hydropower output is 1 per cent in the first year and rises to only 4 per cent by the project horizon. Similar results were obtained for Malawi, where the excess power was judged to be 'very comfortable' for the implementation of the rural electrification projects. In the Rwandan study, the rural electrification demand is termed 'negligible' and in Tanzania it is referred to as marginal compared to the expected hydro output (rural electrification demand would represent 0.7 per cent in year 1, rising to 5 per cent in year 20).



Map 2.
Results of spacial analysis in Giciye, Rwanda, based on the Indicator for Potential Development

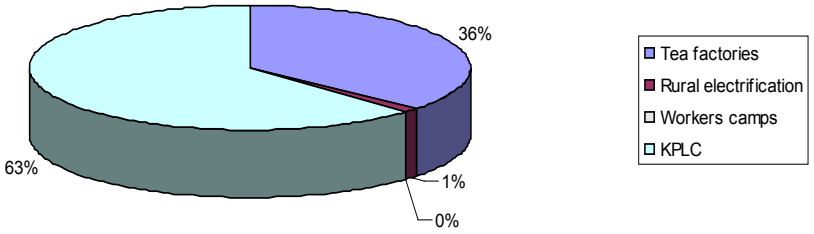


Figure 3: breakdown of hydropower use from Nandi Hills, Kenya in year 1

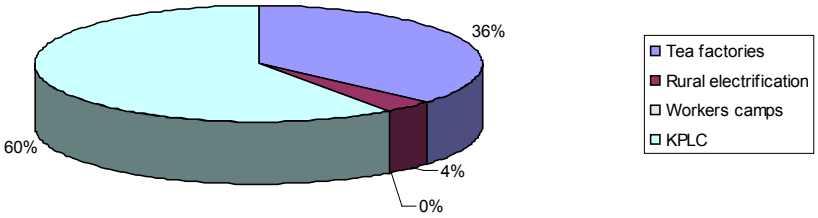


Figure 4: breakdown of hydropower use from Nandi Hills, Kenya in year 20

However, it is not enough simply to look at availability of power in absolute terms: the important question of matching power and demand must also be addressed. Given that the proposed SHPs are "run-of-river", there are significant seasonal variations of hydro output and no storage is possible, therefore matching power supply and demand has indeed to be carefully simulated for each hour of the year. For Rwanda, there appeared to be 'no issue with energy availability [...], ensuring cheaper energy available throughout the year'. In Kenya too the situation was favourable, with the evening peak from load centres almost coinciding with the lowest tea factory activity, thereby improving the overall load factor. In this case, almost all of the rural demand could be met by hydropower (94 per cent in year 1, 93 per cent in year 20)

In Malawi and Tanzania, however, the situation is different. In Tanzania, the seasonal pattern of rainfall means that the hydro scheme would not be expected to meet the demand of the tea factory during the dry season. In fact, projections show a situation in September of the first year in which demand is not fully met: this is illustrated by Figure 5 where hydropower is very low whiletea factory demand remains high. Therefore, even though enough power may be available for the low rural demand, if the tea factory has priority, no power will be left for rural end-users.

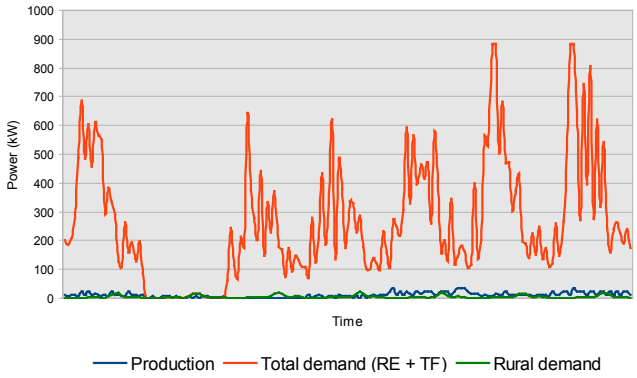


Figure 5: hydro and load curve for first week of September, year 1 of planning period

Similarly, in Malawi, although the 22 per cent of excess power was considered 'comfortable' in relation to rural electrification demand, availability of the energy is not spread evenly throughout the year. In fact, there would be periods during the rainy season when there would be almost no available power, and periods in the dry season when available power would be in excess (and probably injected into the grid). It is suggested that bringing about a slight shift in the times of electricity use for tea factories and/or rural end-users (to move closer to the Kenyan situation) could bring about an improvement.

Financial aspects

PACEAA is in the business of distributing energy, but with an overall goal of reducing poverty not simply making a short-term profit. In carrying out financial analyses of the PACEAA pilot projects it is assumed that project developers would be willing to seek fairly low Financial Internal Rates of Return (FIRR – the standard indicator of project profitability) and financial equilibrium in the long term. FIRRs of 5 per cent were sought for Rwanda and Tanzania and of 6 per cent and 8 per cent respectively for Malawi and Kenya. The retail tariff was adjusted to reach these rates.

The resulting tariffs were then subject to an analysis of the willingness and capability of households' and maize mills' (two typical end users) to pay in a 'business as usual' (i.e. without subsidies) situation, mainly by comparison with prices for other energy sources, including those paid by users connected to the grid.

The analyses indicated that, even in these unfavourable (unsubsidised) conditions, the tariffs were probably affordable by most of the households surveyed, especially given the high cost of the only alternatives such as diesel, kerosene or rechargeable batteries open to off-grid consumers.

However, in the case of Malawi and Tanzania, upfront connection costs could be a stumbling block. This is illustrated by Table 2 which shows the situation for three different categories of Malawian households, classified by level of income.

for smaller units when compared to the cost of car batteries and connection fees were repaid in the first month.

Overall the results tend to demonstrate that the projects have the ability to pay off, if only just, under very unfavourable conditions (no subsidies, grants, etc.). However this overall positive financial picture is somewhat clouded by an important element: all of these unsubsidised tariffs are significantly higher than those for electricity from the national grids and it is considered very unlikely that most potential consumers would be willing to accept a tariff that is much higher than that paid by nearby users of electricity from national utility grids. This leads to an important conclusion summed up in the Tanzania Rural Electrification Plan: '... **subsidies are considered mandatory to make the project happen under reasonable conditions for end users and limited risk for the project developer**'. Solutions are therefore needed to bring tariffs closer to those of the national utilities.

Seeking parity with the grid

Three solutions are put forward to attempt to establish price parity (i.e. same retail base tariff) with the grid:

- To provide a grant on part or all of investments
- To lower the power purchasing tariff (i.e. lower than the tariff that the hydro project developer would normally get by supplying the utility grid)

Table 2: anticipated cost reduction for households of different classes in Malawi and payback of connection fees

	Consumption (kWh/month)	Expected energy bill (MWK/month)	Avoided costs (MWK/month)	Consumer surplus	Payback of connection fees (years)
HH class 1	40	726	1300	44%	3.3
HH class 2	20	430	350	-23%	Infinite
HH class 3	12	323	200	-62%	Infinite

For Tanzania, the PACEAA Rural Electrification Plan states, 'domestic customers would face serious issues in securing initial costs of connection, as shown by current experiences in nearby electrified villages'.

Proposed solutions to this difficulty include pre-financing of connection costs and partial subsidies as well as waiving of connection fees. In Kenya, Rwanda and Tanzania, sensitivity studies of the impact of the latter solution indicated that loss of revenue from no-fees could be offset by small percentage increases in the numbers of customers who would be attracted by such a scheme (7 per cent for Kenya, 6 per cent for Rwanda and 9 per cent for Tanzania).

For commercial users the advantage of switching to electricity is generally clear when compared to the alternatives. Maize mills in the Kenyan study stood to gain a 36 per cent cost reduction and to be able to repay connection fees in 3 months. Milled maize prices also dropped, giving households a 30 per cent reduction while keeping mill profits more or less unaffected. In Tanzania, avoided costs are considerable when compared with recharged car batteries (the usual high-cost source at present) and connection fees are repaid within one month. Large mills using diesel would also see a 26 per cent cost reduction; in the Malawian mills surveyed this saving rose to 46 per cent. In Rwanda savings for the larger, diesel-using, mills was only around 13 per cent but savings were very high

- To treat rural electrification as part of the hydropower project

Results show that for Kenya and Rwanda parity is achieved with 79 per cent and 70 per cent subsidy on all investments (including the ones incurred after the first year of operation) for the normal purchasing tariff. In Tanzania and Rwanda parity is barely or not achieved at 100 per cent subsidy on investments.

The second solution consists in negotiating a more advantageous purchasing price from the hydro project developer. Assuming that developers would be prepared to withstand the resulting loss, for Kenya and Rwanda—with a purchasing price still 20 per cent above hydro production costs—parity is achieved respectively at 58 per cent and 53 per cent subsidy on investments. For Malawi, a 30 per cent reduction in relation to the price applied initially achieves parity at 88 per cent subsidy on investments. In Tanzania a lowered purchasing price would still require 100 per cent subsidy for parity.

A more radical way of improving the financial viability of these projects would be to consider rural electrification as one aspect of the hydropower generation projects with which they are associated (Box 1). In fact, this is a form of cross-subsidy, with profits from the generating project being used to support rural electrification. Analyses indicate that this solution

would increase project investment costs in the four core countries by between around 5 and 8 per cent and that IRR would be reduced by around 1 per cent.

Economic aspects: hydropower or grid extension?

The financial analysis above has looked at project profitability from the developer's point of view (FIRR) but it is also necessary to consider the economic internal rate of return (EIRR), an indicator which gives a picture of project profitability from the point of view of society as a whole.

Such analyses were conducted for Kenya and Tanzania. In both cases the EIRRs were superior to those calculated for supply from the grid alone. In a further comparison, the Kenya study found that, when comparing the costs of existing rural electrification plans, the much lower production cost from hydro schemes compared to the grid marginal cost (and the relative proximity of proposed RE projects with hydro schemes) led to levelised cost for hydro that was more than 60 per cent lower than for the grid. From the point of view of society as a whole, it would therefore appear sensible to suggest electrification from the proposed hydro schemes, even though some level of subsidy may be necessary to make them financially sustainable.

To conclude this discussion of the technical and financial aspects of PACEAA, Box 3 gives a round-up of the most salient points.

Box 3:

technical and financial round-up

The methodology developed by PACEAA, using the IPD indicator, ensures optimum benefit from electrification.

All of the projects are technically sound in that power over and above the tea factories' needs would be available and the proportion of all power produced by the hydro schemes that would be used for rural electrification remains small throughout the 20 year project horizon. In some cases, attention must be paid to matching the availability of supply with demand, possibly by compensating seasonal variation of hydro power with the utility grid.

Where project finance is concerned, studies indicate that the retail tariffs required to achieve acceptable levels of IRR would be affordable for most households and commercial units surveyed in the project areas, although in some cases upfront connection costs could be a problem. The major challenge, however, is that retail tariffs are far higher than the (often subsidised) tariffs for electricity from the grid, making them socially unacceptable.

Three possible solutions are proposed:

- grants on all or part of investments,
- negotiating a lower purchase price from the power producer, and
- a more radical solution: cross-subsidising by treating rural electrification as an aspect of the hydro scheme generating the power.

Generally, it is clear that subsidies would be necessary to provide reasonable conditions for project implementation and to limit risk for project developers to acceptable levels.

Economic analysis, placing the focus on the benefits for society as a whole and not just for the project developers, indicates that the lower production costs of hydro power and their proximity to the proposed projects, make such projects a sensible suggestion even though some level of subsidy would be necessary.

Business models

Pursuing PACEAA's overall goal of involving an industry in helping to alleviate poverty and stimulate development by provision of clean and sustainable energy means, to some extent, reconciling aims that—in traditional business terms at least—could appear divergent. In this context, the business model, i.e. the structure that actually brings together the different stakeholders in producing and delivering the power, is a vital factor in ensuring that social development is prioritised alongside the pursuit of economic growth.

There are a number of possible approaches to rural electrification using electricity from hydropower generated by the tea industry and it is the business models which largely determine the approaches, the models themselves being optimised to achieve maximum socio-economic benefits, particularly poverty reduction. In the models considered for PACEAA the tea factories and benefiting communities around them are key players.

In the PACEAA programme, the electrification or distribution business is expected to receive electrical power from the tea factory or from a designated generator, and to provide supply to community members through a local distribution network. In general terms, such a business could be carried out by any organisation or person. However, in view of the strong connection between electrification and community welfare, it is important to involve the community either as the business owners and operators or as substantial stakeholders.

Regardless of the ownership or undertaking, financing is a critical input for any such project and a decision about the right business models can only be made after examining available forms and sources. PACEAA projects, given the likelihood of a low or negative financial return on investments, would be unlikely to attract profit-making organisations already in the business. Social returns on the other hand would be high and interest would be more likely to come from development-oriented institutions.

The most probable sources of financing would therefore be micro-credit institutions, cooperative savings, credits societies, and development funding agencies, the latter including bilateral and multi-lateral donor institutions, governments (represented, for example, by rural electrification funding bodies) and charitable organisations.

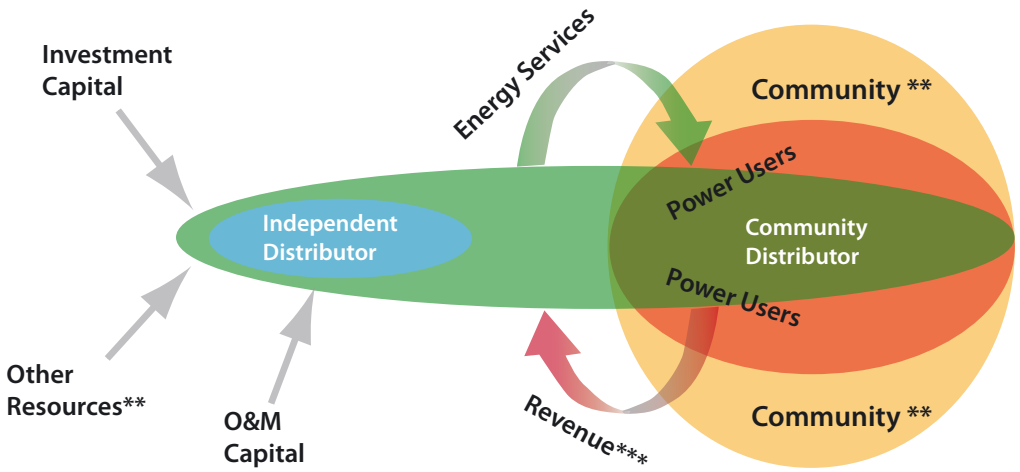
Another important source of funds can be the Fairtrade premiums which Fairtrade Labelling Organizations International (FLO) provides in respect of tea grown and marketed according to FLO standards. By way of example, a community organisation in Kenya combining this source with members' contributions has raised around 40 per cent of the capital required for purchase of a tea factory

However, although development funding would be the substantial source of finance, commercial co-financing is increasingly being demanded as leverage for soft funding, in order to ensure sustainability of community-based initiatives. Moreover, benefiting communities are expected to make significant in-kind contributions in addition to any financial inputs they can raise. Such contributions reinforce communities' commitment to the initiatives and, once again, increase sustainability.

Power distribution models

The purpose of the distribution models discussed below is to demonstrate business arrangements that could enable power purchased from a power generator by an intermediary to be distributed to end users in a manner that is in keeping with PACEAA's overall goals.

Figure 6: generic model of distribution business with community of independent distributor



Key potential sources of inputs
Investment capital: Commercial loans, MFI credits, equity, government subsidies, donor and NGO funding, carbon and other climate-change related funds, etc.

O&M Capital: Commercial loans, MFI credits, equity, government subsidies, donor and NGO funding, etc.

Other resources: Contributions from corporate organizations, government and local people (community)

Figure 6 shows a generic model for a distribution business, where members of rural communities around tea factories are the end-users. The illustration indicates that there could be an independent distributor supplying power to the community (or communities), or the community could be a distributor to itself, with a section of it comprising the power users.

The strengths and weaknesses of some derivative versions of this generic are presented and discussed below.

Rural community organisation as distribution enterprise
An ideal situation for electrification leading to greatest benefits for the community would be where an organisation that is self-managed by the community owns and runs the distribution business. For instance, the organisation could mobilise resources to build a distribution system that closely meets community needs, and beneficiaries of the electrification could contribute substantially towards system construction, both financially and in-kind. Items like labour, land, and materials could be provided by the members as part of their contributions.

Similarly, operation and maintenance could be manned by local labour, expenditure could be minimised through use of appropriate technology, and good care of the power system would be ensured by the community's sense of ownership. Such an arrangement could be especially effective in reducing poverty and could be highly sustainable.

The electrification business could be even more successful if the community organisation were to be a properly constituted cooperative. Rural electrification in countries like Bangladesh and the Philippines has flourished largely as a result this type of approach, mainly because of the empowerment of members that arises from the principles upon which sound cooperatives are founded. Key amongst these are equity of membership (one member one vote), well enforced regularity of general meetings, and effective membership education.

Such an electrification initiative would be a good candidate for donor funding, given the high potential for socio-economic development associated with a community-driven business. Conversely, the initiative would have a low eligibility rating for commercial financing because most of the community members would have very few business and technical skills and the commercial risks are high.

To remedy this, success of the electrification project could be greatly improved by building the community's capacity via, for example, support from an NGO facilitated by donors. As skills improve and performance is enhanced it should become easier to secure finance from commercial sources. It would also be possible to gradually reduce any subsidies on running costs as the community's capacity increases and performance of the business improves, thus paving the way for a more sustainable electrification process.

Rural community and tea factory as combined distributor
This combination would benefit from the fact that the tea factory will have built-up competence as a business organisation over time and would therefore be in a good position to help the community in electrification. The tea factory's involvement would not, in this case, be motivated by commercial considerations, since the profitability level of an electrification business is generally low. Instead, this would be more an exercise in social responsibility or would be motivated by the sense of obligation arising from the economic ties between the company and the local people.

The major advantage of this type of configuration is that inclusion of the tea factory, with its business capacity, could greatly enhance the commercial attractiveness of the initiative, making financing easier to obtain from banks and other commercial institutions and on better terms, since the trading risk would be viewed as being lower. It is also likely that there would be interest in the initiative from donor agencies, which would be willing to provide support for fostering the development dimension of the enterprise. Overall, such an initiative would have good potential for success.

Energy service company as distributor

Energy service companies (ESCOs) are just beginning to emerge in developing countries and getting one to participate in rural electrification at present would be challenging. However, this model is worthy of mention since there is potential in their involvement, either alone or in partnership with the community.

There are two major advantages to this type of scheme and two disadvantages. A distinct advantage is the fact that electricity is the core of the ESCO's business, meaning that it should perform significantly better than a tea factory in carrying out electrification. Associated with this is the fact that an ESCO would obtain investment financing more easily as a result of its expected performance.

On the down side, a tea factory may be more willing to accept lower profitability and apply a degree of social responsibility in providing power to the community. This would facilitate acquisition of donor funding, which an ESCO would find difficult to obtain if the initiative needed to be co-financed. And there would be greater support to the tea factory from the community due to the tea trading ties that already exist between them.

Rural community and ESCO as distributor

The outcome of this type of combination could be the 'ideal situation' described above, i.e. an organisation self-managed by the community owning and running the distribution business. For instance, an ESCO could be tasked with building up the distribution system and with training local people to take over management of the distribution business.

ESCOs are, however, generally designed to run as commercial concerns and such a partnerships would be unattractive to them unless the partnerships could be facilitated by a third party. The third party envisaged would most probably be a funding or development aid agency that would help in providing finance to assist the ESCO in getting its required returns.

The major advantage of this arrangement is that the rural community would eventually become the distributor operating with the advantage of having community members' capacity built by the ESCO and therefore with better expected business performance.

Rural community and NGO as distributor

This type of partnership could also be ideal for the start up of a distribution business and for capacity building for the community. The situation would be similar to that described above but the NGO would be more concerned with development and less with the commercial aspect of the business than an ESCO, thereby making development funding easier to secure. One drawback, however, is that the NGO would very probably lack competence in the electricity business, which may necessitate employment of trainers for the technical aspects of the business.

Public utility as distributor

A public utility could combine its existing distribution business with provision of supply to the community. In this case, community members would be served on the same terms as other utility customers.

In some cases, the utility could set up the distribution system and, while continuing to own the system, could lease it to the community. Under such an arrangement, the community would use the system to run a distribution business, thereby helping to build the community' capacity both for the power business and for socio-economic growth.

Fitting the models to reality – an example of methodology

Models are, by their nature, generic but simplified representations of real situations, so the next important step in the PACEAA process was to test which of the business frameworks outlined above could lead most effectively to the programme's desired outcomes.

The first step here was to analyse the models' potential by screening them against a set of nine general criteria applicable separately to generation and distribution businesses. The criteria were based on a specific requirement: the selected model must enable a sustainable improvement in socio-economic standards for the targeted rural populations. For the electricity distribution business the criteria were:

i. **Competence of organisation to start and run a power business**
   -- Existing capabilities of the organisation to run a power business are considered here

ii. **Expected level of electricity business performance**
   -- The projected performance of the body under consideration is gauged on the basis of experience of similar organisations running power generation businesses

iii. **Commercial financing attractiveness**
   -- The general trend amongst commercial institutions to lend (or not) to this type of organisation is examined; credit-worthiness and lending risk level are important factors

iv. **Donor financing attractiveness**
   -- The degree to which donor assistance to the organisation would effectively support development for poor or disadvantaged populations would be an important consideration here

v. **Level of connection to local communities and interest in local development**
   -- The greater the degree of connection between the electricity business organisation and the community the greater the social benefits that can be expected from the business: communities would be willing to reciprocate any assistance they obtain; synergy would be highest if community members are involved in running the business.

vi. **Level of support expected from local communities [to use their lands, willingness to relocate where necessary, grant of wayleaves consents, etc.]**
   -- This follows on from criterion *(v)*; support tends to be strongest when communities have a sense of ownership of the electricity development

vii. Level of interest in small rural projects and importance that could be attached to them

-- The higher the level of interest here the greater the likelihood of an initial decision to invest in the business, and of success of the envisaged business once it is started

viii. Willingness to build the capacity of rural people

-- Building local people's capacity so that they eventually run the electrification business themselves is important for sustainability and should be targeted wherever possible

ix. Freedom from political interests

-- To protect against rent seeking behaviour

These criteria are applicable to all of the 11 countries covered by PACEAA and, more generally, to the whole of sub-Saharan Africa. For the four pilot countries they were used to rank the different models in terms of their capacity to lead to the desired PACEAA outcomes.

Ranking is illustrated by assessment tables of which an example is shown as Table 3 (for Kenya). Here the different models (e.g. community based association, community + ESCO, etc.) are assigned scores from 1 to 3 for each of the criteria enumerated above, assessed for a particular country's situation. The total scores indicate ranking of the models with regard to suitability for that country.

there is an existing community organisation already set up as a company and suitable NGOs exist in Kenya.

From the tea factory's point of view, partnering the community in this venture by investing in the project is unlikely to be attractive given the high level of risk and expected minimal or even negative returns. In fact, the factory's management has already expressed reluctance. The factory could however lend support as part of its CSR effort providing, for example, some technical training or in accountancy and book-keeping.

Similarly for Malawi Rwanda and Tanzania, the models that emerge as most desirable at this stage of analysis are those that have some form of community involvement via community associations or cooperatives. However, although these are seen as the best options for achieving poverty alleviation benefits from rural electrification, severe project implementation challenges remain that ultimately led to the selection of another model.

In Tanzania for instance, where the SWOT analysis points to a community plus tea factory model as being optimum, the tea factory is in fact very reluctant to get involved in rural electrification and this is also the case in Rwanda. In these two countries the community acting with a partner NGO guiding and building the community's capacity for electrification, as

Table 3: assessed scoring of the distribution business models according to each criterion

MODEL	CRITERIA SCORE (Scale of 1 to 3)									
	Business competence	Business performance	Financing attractiveness	Donor funding pull	Affiliation to communities	Community support	Interest in rural projects	Interest in capacity building	Freedom from politics	Total
C.B.* Coop	1	1	1	2	3	2	3	3	1	17
C.B. Association	1	1	1	3	3	3	3	3	2	20
C.B. Company	1	1	1	3	3	2	3	2	2	18
Comm + TF	2	2	2	3	2	2	3	2	2	20
ESCO	3	3	3	1	1	1	1	2	3	18
Comm + ESCO	2	2	2	2	2	2	3	2	2	19
Comm + NGO	2	1	1	3	3	3	3	3	2	21
Power Utility	3	2	2	2	1	1	1	1	1	14
	Maximum attainable score = 27									
Note: actual ranking made use of a table of weighted scores for each criterion. However, this unweighted version gives a clearer illustration of the principle										

To focus the analysis further a final assessment was made in each case, in the form of a SWOT analysis of the three highest scoring models (indicated in red in Table 3), allowing models to be recommended for the different countries. Then, as demonstrated by the outlines of the situation in the four pilot sites presented below, this was compared and contrasted with the situation in the field to arrive at the most suitable model.

Models for the four core countries

In Kenya, the most suitable option was found to be the community working alongside an NGO acting as facilitator. This was selected because

well as securing funding is a theoretically attractive model, but the challenge of raising adequate funding and support is a major one.

In fact it is the power utility model that emerges as the most attractive in Malawi, Rwanda and Tanzania once all of the circumstances surrounding the three models indicated by analysis have been taken into account. The key attractive feature of this type of solution is the possibility of calling on well established power business resources that should minimise project implementation time. The drawback is that the model leaves little or no room for community involvement, which tends to mean that the level of

social benefits from the project are not as high as they would be from a community implemented and run project. This could be offset to some extent by labour and in-kind participation by the community, thereby building a sense of project ownership.

Creating an enabling environment

An appropriate policy and regulatory environment is a crucial requirement if PACEAA's objectives are to be met and rural communities are to obtain the intended benefits. Most of the countries included within the scope of PACEAA have the right environments or are on the way to creating them. The background to development of this environment is described below, throwing light on some of the drivers. Some examples of the major elements constituting such a framework are given and the status of the four PACEAA pilot countries is presented in a 'round-up'. Lastly, a needs assessment summarises other challenges that need to be addressed to provide an enabling environment for all of the stakeholders.

Background of energy sector reform and policy development

Engagement of the private sector and other non-state actors in provision of electrical power in developing countries is a fairly recent phenomenon that began with a wave of energy sector reforms at the close of the 20th century.

Box 5:

private and community efforts in Kenya

In parallel with the official rural electrification programme (REP), there has been a private rural electrification effort by entrepreneurs and individual groups. The most common type of electrification in this category is solar photovoltaic (PV) power supply that is aggressively marketed by solar power businesses.

There has been little intervention from government in the industry apart from removal of import duty for solar panels. It is estimated that close to 200,000 PV power installations have so far been put up around the country.

There is also a growing number of rural community groups undertaking projects to supply themselves with power from renewable energy sources, mainly small hydro.

While NGOs and donor agencies have been supporting such groups financially and with technical assistance, there is significant contribution by the groups themselves.

On the whole, the private form of rural electrification has been carried out with a bottom-up approach, and has manifested itself as the way forward for sustainably meeting the modern energy needs of rural people in the country. It provides useful lessons for initiatives like the PACEAA Project.

Box 4:

selecting the business option – round-up

Rural electrification using electricity from hydropower generated by a tea industry could be approached in a number of ways and the business models adopted for power generation or distribution are major factors in determining approach. It is therefore important to optimise the models to ensure that they help to achieve maximum socio-economic benefits, particularly poverty reduction. PACEAA provides a methodology for optimisation, summarised below:

- Based on a generic business model, PACEAA proposes a set of models aimed at achieving the programme's overall aim of helping to reduce poverty by providing clean energy.
- A method is described whereby the models can be screened against a set of criteria to rank them in terms of their potential to achieve the prescribed goals.
- Further analysis of the highest ranking models is described (SWOT analysis) and the desirable models are assessed against the actual situation in the field (the four pilot sites in the case of PACEAA).

Initial analyses led to the conclusion that in the four countries selected for piloting (Kenya, Malawi, Rwanda and Tanzania), distribution models that have rural communities at the core of the electrification businesses are most favourable. It is thought that getting the members of the communities that are the targets of electrification to own the electrification process and businesses will maximise benefits to the communities and ensure sustainability of the initiatives.

Community based electrification businesses in the four countries would be well supported by energy sector policies and regulations that already exist or are in the process of formation. In addition, key institutions like international development agencies, governments through national rural electrification bodies, NGOs, and micro-finance bodies are willing to support the businesses.

However, there are major challenges. Community organisations would find it very difficult to start and run electrification projects on their own since they generally lack adequate technical and business capacities. Joint development of electrification by the community and tea factories was proposed as an alternative, but the tea industry was found to be reluctant to get involved substantially in the risky business of rural electrification. Development with NGOs was therefore put forward as the most feasible alternative, although this solution is also not free of considerable difficulties in finding support and funding.

In the light of the difficulties encountered in securing resources for empowering communities to do rural electrification it has been found possible, in some cases, to revert to a model where national power utilities would be the rural electrification providers. This model has the advantage of greatly simplifying implementation given the utilities' capacity and experience of the electricity business. A significant drawback is that communities are unlikely to be involved in the electrification and poverty alleviation benefits may not therefore be fully realised. This model can, nonetheless be proposed as a first line of action towards implementation of rural electrification.

This process of reform took place as governments—realising the increasing difficulties of grid extension by monopoly suppliers—decentralised their national power systems and increasingly turned to the development of renewable energy sources. As part of the transformation process, the sub-national and private actors who entered the field were to become drivers for changes in policy (see Box 5). In some cases electrification efforts preceded the formulation and implementation of legislation allowing communities to provide their own electricity supplies. It was the supporters of these community developments who in many cases took part in lobbying for policy change, leading to laws granting rural people the right to produce and supply electrical power.

From the early 1990s trail blazing countries undertook policy and regulatory reforms entrenching and further promoting RET-based and decentralised electrification. Important elements of planning, laws, and regulations were formulated and put into effect to actualise the emerging form of electrification.

These improvements in the enabling environment were so attractive that they elicited considerable interest from financial institutions, industrial and institutional investors, and new public sector entrants. These players widely took up public-private partnership roles in electrification businesses, and as a result of their contributions, rural electrification using locally available renewable energy sources picked up tremendously. Countries such as China now have electrification levels of nearly 100 per cent, mainly as a result of the reforms and responses to them.

Conversely, in developing countries in sub-Saharan Africa there is very limited rural electrification using renewable energy. Overall there has been dependence on grid based power for rural electrification, which has become increasingly costly to provide as deeper rural areas are reached. As a result, the level of access to electricity in most rural areas is below 5 per cent.

Some African countries have nonetheless been more dynamic, including Ethiopia, Uganda and PACEAA countries in which efforts have been made, e.g. Kenya, Tanzania, Sudan, and Rwanda. In Ethiopia, for example, the government has set a strategic goal based on two pillars: an ambitious grid extension programme; and implementation and operation of off-grid supply systems in rural areas by the private sector or community based organisations. In Uganda, government policy recognises that providing access to rural populations requires special measures to make connections and services accessible.

Implementing policy reforms

To enable implementation of policy reforms laws are passed and new institutions created. The two most prominent types of institutions are regulatory and rural electrification (or energy) bodies.

The first of these is necessary because the increased numbers of players in the more open energy sectors require close regulation. The second type of body is equally important to provide an impetus for and accelerate growth of modern energy supply in rural areas, hence the creation of bodies specifically handling rural energy or electrification matters. The degree to which an appropriate framework is present in the four PACEAA pilot countries is summarised in Box 6.

Box 6:

policy round-up – implementation of policy framework in four PACEAA pilot countries

Kenya: there is ample evidence of definitive steps being taken to implement reforms in the energy sector: timely enactment of relevant laws and setting up of necessary institutions; encouragement of small scale power production; use of renewable energy sources; and rural communities' energy supply initiatives. A further example: the recent introduction of tariffs for production of power by small IPPs based on renewable energy sources sends a very clear signal of government intention to increase availability of power and promote sustainable sources of energy.

Malawi: The policy and regulatory reforms that were started under the 2003 Energy Policy are well underway, although the pace of implementation is slow. A significant increase in utility retail tariffs would be necessary to reduce the utility deficit to reasonable levels, allow interconnection with neighbouring Mozambique (to solve the current power shortages), and make hydro feed-in tariffs more acceptable. However, this is a politically sensitive move and will probably take time. Further, it is expected that with the full establishment of the energy regulatory authority (MERA) substantive action will be taken to transform the energy sector.

Rwanda: sector reforms have accelerated, though much remains to be done: reforms are ongoing under the Competitiveness and Enterprise Development Project. A significant milestone in the reform process was the national utility's management contract with a private organisation. Electricity and Gas laws as well as utility regulation still have to be prepared. Despite official liberalisation of the power sector, only a few IPPs are operating currently. Given that the national power utility will probably continue operations as a state-owned vertically integrated, legacy provider it is unlikely that market opening will proceed beyond an early stage wholesale market.

Tanzania: It is manifestly clear that there is a dedication towards implementation of recent energy policy reforms in Tanzania. Laws such as the Rural Energy Act 2005 (REA) which promote rural electrification, and the fairly rapid setting up of electricity related functions of REA, are steps that augur well for the energy sector. Further key changes are expected to take place when the implementation of the Electricity Act 2008 starts. The introduction of competition for electricity businesses (with feed-in tariffs in particular) that has been solely carried out by TANESCO is bound to improve efficiency in the whole power industry.

Providing an enabling environment for all stakeholders – a review of stakeholders' needs

Over and above the government policy and regulatory framework addressed above, analysis of the PACEAA programme's review of national frameworks for the involvement of agro-industries in rural electrification indicated some common needs that must be met for all stakeholders if project goals are to be attained. The needs assessment presented below gives some clear pointers as to what can be done to provide an environment that is conducive to successful rural electrification using power generated by agro-industries.

Rural Communities (beneficiaries of rural electrification)

If community members are to obtain electrical power and use it for effective and sustainable livelihood improvement, they require capacity building and other forms of facilitation as follows:

(i) Awareness Raising

Most community members know the benefits of electricity, and many of them will have attempted (unsuccessfully) to gain access to electricity through government rural electrification programmes. However, they are generally not aware of the possibility of obtaining power through community-based or local initiatives. It is therefore necessary to augment communities' knowledge and awareness.

(ii) Linkage to Capacity Building Agencies

Establishing links between the communities and agencies or Development Organisations (DO's) that can provide capacity building is necessary. DO's are, for example, NGO's, community-based organisations (CBO's), or other institutions responsible for rural community development.

(iii)Organisation, Training, and Project Funding

Once rural communities start working with DO's the initial tasks would be to organise and train the communities. Typically, organisations could be cooperatives, associations, or private companies, all with legal status. Training would be necessary to ensure that community members are equipped with the skills to run the organisations sustainably and to project development, including preparation of funding or financing proposals and, most importantly, to carry out businesses cost-effectively.

Agro-industries

Agro-industries are very likely to be aware of the possibility of producing energy from local renewable sources for their own use, but it is unlikely that they would wish to engage in initiatives to supply the communities around them with energy–the normal expectation is that the communities would be considered for electrification through government programmes. Furthermore, the industries will probably not be aware of the potential benefits to them of participating in rural electrification. Meeting needs such as those below could help to bring agro-industries to contribute to rural electrification of local communities, and in return benefit from better performance. The main needs in this respect are:

(i) Awareness raising and Involvement in PACEAA (or similar projects)

The necessary awareness could be created via information dissemination activities and participation in stakeholder meetings. Commitment and action by the industries towards implementation of the project would be sought after underscoring the project's benefits to the industries.

(ii) Assistance in Identification of Funding for Small Hydropower Projects

Although the focus of PACEAA is distribution of electricity from agro-industry based SHP schemes for rural electrification, the agro-industries would be seeking funds or finance for generation of the power. It would therefore be beneficial under PACEAA type programmes to make efforts to identify funding sources for the agro-industries and to pass the information on to industries wherever possible.

NGO's and Similar Development Organisations

DO's are critical for the building of rural communities' capacity but they also need support to carry out this task. Therefore, like agro-industries the DO's could be greatly assisted by identification of possible support for their participation in projects and beyond. DO's main needs are:

(i) Awareness raising and Involvement in PACEAA Project

(ii) Assistance in Identification of Funding

Other Stakeholders

Other key stakeholders include government departments, funding and technical assistance agencies, financial institutions, and consultants. As project facilitators, their main needs are for greater awareness and for incentives to involve themselves in projects. These needs can be addressed via information dissemination, participation in meetings, and other forms of engagement.

Outcomes and lessons learned

A unique feature of PACEAA is that it brought together an unusually wide range of potential partners. On the one hand there are businesses, concentrated on their core activities and often unaware of the potential they have to assist with electrification of the communities surrounding them and from which they draw their workforce. Unaware too of the advantages that could accrue to them from the social progress electrification would bring, and reluctant to engage in the business of power distribution. Then there are the rural communities, often with dynamic community associations (see Box 7) and needing clean, modern energy, but unaware that community organisations not just governments can be involved in rural electrification, or unaware of how to kick start their involvement. NGOs and policy makers, regulatory bodies, power planners, engineers or energy service companies with an interest in rural electrification are also potential stakeholders.

Box 7:

Outgrowers Empowerment Project, Kenya

OEP is a community-based association representing 4,000 tea farmers set up as a for-profit business. The farmers supply around 30 per cent of the tea processed by the neighbouring tea factories. Business is good and OEP, with its strong social-equity orientation and additional funding from the FairTrade system is in a position to potentially contribute one-third of the rural electrification investment for PACEAA's Kipchoria project.

Addressing such a diverse group is something of a balancing act but PACEAA's strength was that it addressed the full complexity of achieving its goals by speaking both the languages of business and of development. Its deliverables, in the form of the business plans, rural electrification plans and policy review, form a comprehensive set of methodologies and tools for rural electrification planning that are attentive to and understandable by all of the stakeholders.

The project's work and results were also disseminated widely at four-day meetings in the PACEAA core countries, between July and October 2009. The tools and methodologies were presented and discussed in depth, with a focus on how they could be adapted to the needs of different

countries. Many of the stakeholders attending the meetings were already involved in similar undertakings and their experience and knowledge enriched the meetings. Training workshops were also organised, notably one entitled 'Technologies for Least Cost Rural Electrification' (Kigali, 12–16 July 2010) where delegates from the four PACEAA pilot countries and from Burundi, Uganda and Denmark, France and Germany, were able to share technical options for optimisation of system sizing and of equipment choices that are helping to cut costs. A wrap-up meeting was held in Mombassa in partnership with the Club E.R. (an association of stakeholders, initially exclusively from Francophone African countries, with a common interest in rural electrification). The workshop established an important link between Club E.R., PACEAA and EATTA, as well as raising awareness among donors such as French Technical Assistance (AFD) and the EU Delegation to Kenya.

The PACEAA programme was scheduled to run for three years, meaning that it has come to an end two years before the planned SHP schemes are up and running, since the plants are still under development by the GTIEA project. But the programme has shown that there is a real untapped potential for increasing access to power if agro-industries commit to new investments, and that institutional organisations are willing to review policy and regulatory frameworks to facilitate the electrification process. It further demonstrated that, while willingness and intentions may exist, implementation remains hampered by a lack of clear models that could be easily replicated, resulting in hesitation on the part of the industries and other stakeholders to get involved. In response to this, the programme has produced a set of deliverables that identify barriers, highlight opportunities and provide resources for planning of rural electrification at target sites.

In the absence of operating small-hydro plants, there will be no further action in the immediate future but, via its outreach activities, PACEAA has tried to ensure that enough interest has been kindled amongst local actors to ensure that there will be a continued demand on their part in the future.

Further background on all aspects of the project can be obtained from the PACEAA website (www.paceaa.org) which features not only a wealth of information about the programme, but also allows visitors to download the rural electrification plans that were tailor-made by the UNEP-Risoe Centre and IED for the four pilot sites. There is also a direct link to the PACEAA GIS platform, a special site dedicated to a GIS application that allows users to create interactive maps, analyse spatial information, edit data and share their results.

PACEAA Partners

UNEP Risoe Centre
www.uneprisoe.org

East African Tea Trade Association (EATTA)
www.eatta.com

Innovation Energie Développement (IED)
www.ied-sa.fr

AFREPREN/FWD
www.afrepren.org

United Nations Environment Programme (UNEP)
www.unep.org

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