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Electricity where the sun shines

Village electric grids for creating rural income

A solution for remote villages off the grid in Lao PDR

Sketch of an operational concept,
and proposal for a pilot effort aimed at building an investment program

Sunlabob, 24.January 2006

SUMMARY

In Lao PDR about 40 locations are presently known, where hybrid electric village grids can be envisaged: Small hydraulic turbines, solar panels and a biofuel generator set all feed into a grid that serves a whole village. However, due to the low load factor of insular grids (ie. the produced energy compared to the sold energy) such local small grids are usually unattractive investments for private investors, particularly if they have to invest into fixed infrastructures. On the other hand, the public is rarely in a position to raise the required capital to operate such grids even though there is a high public interest in ensuring electricity also in remote villages.

Against this background an innovative operative set-up is proposed. Thereby public investors pay for the fixed infrastructures (civil works and grid) and private investors pay for the movable assets (generating equipment), operated by a “Private Energy Provider”. This PEP also trains and coaches the village energy committee to operate the village owned grid. PEP then sells energy into the village grid, and the village sells energy to households and small rural enterprises. A number of interesting win-win situations arrise out of this set-up which allow flexibility both on the public village side and on the PEP side.

In order to test and demonstrate this concept a pilot project is already explored and proposed in Nam Kha, where a derelict hydraulic turbine allows to utilize already existing fixed infrastructures. Industrial partners from Germany have already been contacted and show interest in providing part of the generating equipment, while the source for funds to refurbish the fixed public infrastructures is still being sought.

This pilot project shall provide the data to show that this concept is economically viable. The results shall allow determining the parameters for building sound business plans for a Public-Private investment program for rural electrification in Lao PDR. The pilot village shall also be a demonstration for other villages and local authorities, who can come and exchange with their peers in the village about the experiences being made.

Total costs for this pilot are projected to be **150.000 USD**, and yearly cash flow is expected to be around **8.000**, to be verified by the pilot.

CONTEXT

A large number of villages in Lao PDR will not be connected to the main grid for many years to come. Small village grids fed by decentralized local energy sources are the option to be explored and developed. In some places it is feasible to consider small hydro-electric solutions. However, in most areas the flows in streams are considerably reduced during the dry season. A feasible small grid will therefore in most cases have to be boosted with solar generators or with a generator set operated on biofuel from Jatropha. This means hybrid hydro-solar-bio fuel village grids.

The government policies support decentralized solutions in order to reach the goal of 90% electrification by 2020.

Insular grids have an intrinsically low load-factor (sold energy compared to produced energy), because they cannot draw on the larger grid to cover peak consumption or feed into the larger grid during low consumption. This makes it unattractive for private investors to consider installing and operating such hybrid grids.

Sunlabob is a Lao company that has been active in the renewable energy sector in Laos for the last 5 years. Most systems installed by Sunlabob have in the past been solar for lighting, water pumping, cooling and communications. A successful innovation has been the development and operation of a rental scheme for solar home systems and more recently communally owned systems for schools and health posts. This effort has been awarded the Development Marketplace prize of the World bank. More recent efforts are for initiating productive use of electricity in remote villages. A pilot project with solar pumps for intensive horticulture is under way. Another project aims for integrating the tested biofuel technology from Jatrhopha curcas into the Lao rural electrification efforts.

In view of the government's policy for decentralized energy production in remote areas, and in view of repeated requests by villages and district and provincial authorities, Sunlabob has looked into the possibilities of small hydro-power generation and the operation of village grids. The required technical know-how is being acquired by Sunlabob through partnerships with industrial partners who provide the equipment. The operational and logistical competence of Sunlabob based on the successful decentralized service system of Sunlabob and with the rental services point the way for designing the operations of village grids for these remote villages.

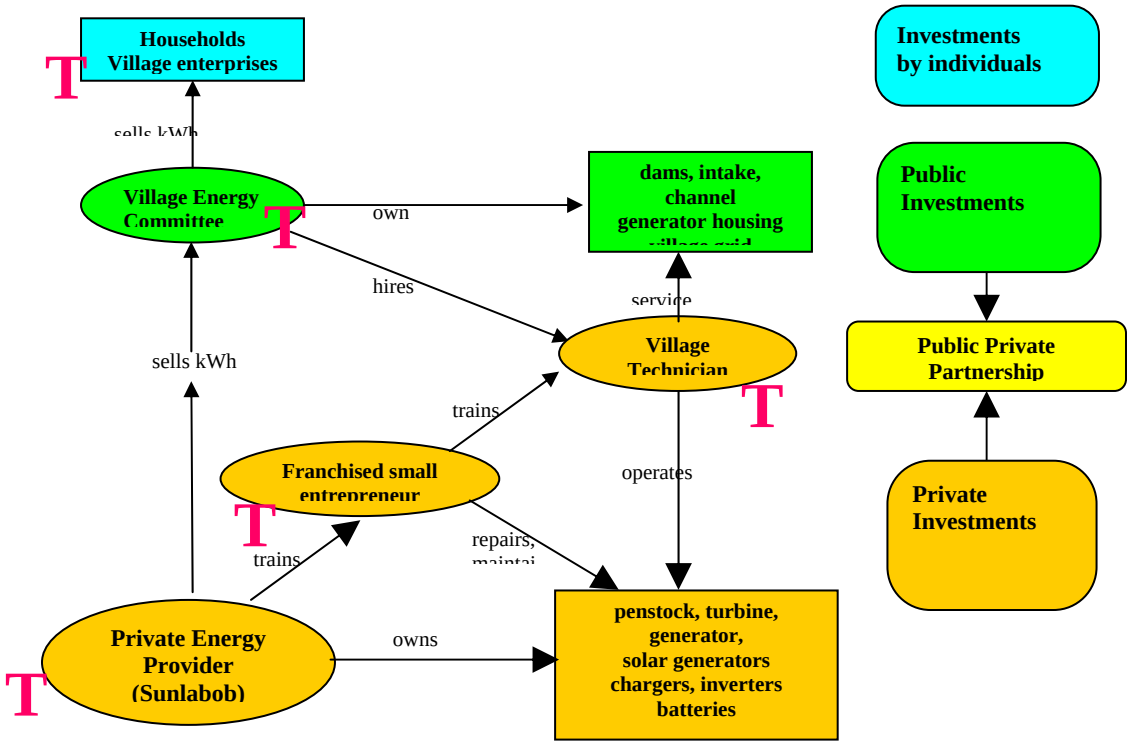
CONCEPT: VILLAGE-LEVEL HYBRID ELECTRIC GRIDS FOR LAO PDR

Insular village grids with their intrinsically low load factor (energy produced in a 24-hour period compared to energy actually sold in this period) and the required infrastructures at village level are an unattractive investment for private investors. And yet there is a high public interest for making them possible because with a AC grid (as opposed to DC individual solar systems) productive use of electricity comes into reach for villages who will not have a chance to be connected to the national grid for many years.

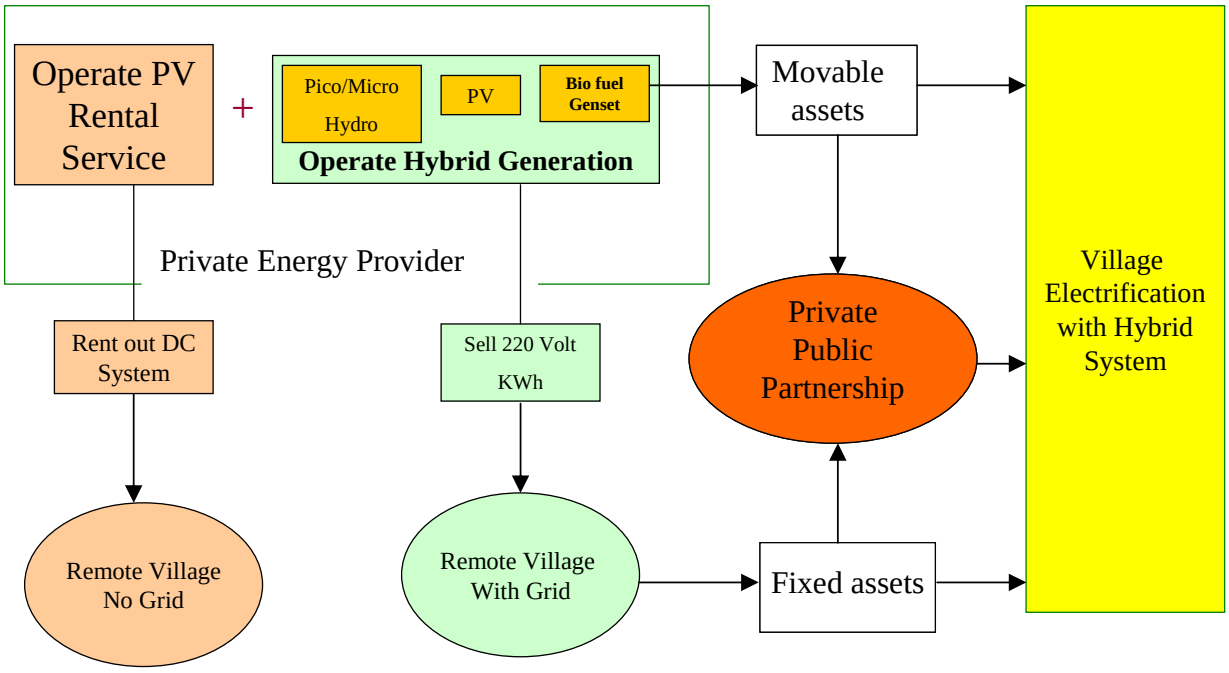
With this in mind, an innovative financial and operational structure is proposed that allows private and public investments to leverage each other (also see graph):

a) All movable assets of a hybrid energy supply system shall be owned and operated by a Private Energy Provider (PEP), i.e. turbines, generators, solar panels and controllers, batteries, etc.
b) All fixed-unmovable assets shall be owned and operated by the village: Dams, intakes, channels, housings, supporting structures, the grid.
c) The PEP sells energy to the village-owned grid. The village sells energy to the individual users.

Private-Public Partnership for Village Grid



PPP For Remote Village Grids



- The village will invest in its fixed assets. If the village does not have the financial means, the investments must be made by higher levels of the public, including donor agencies. This is in line with policies for public support for rural infrastructure.

- The PEP will invest in the movable assets. If the PEP does not have the financial means, of course credits, loans and other private financing mechanisms will facilitate these investments. This is in line with policies to promote private investments.

Thus a close cooperation between Public and Private evolves, that allows to operate village energy supply on an economically viable basis. Public infrastructure investments leverage private investments into the movable assets, and vice-versa the willingness of private investors for operating the movable assets allows the public to save on scarce public funds for ensuring that village grids actually become operational. Initial pilot efforts along this line will provide the data for designing further joint Public-Private investments for rural electrification on a large scale.

The Lao government's efforts for electrification take decentralised energy production and distribution very much into consideration. This paper sketches some details for exploring and developing Public-Private cooperation for ensuring sustainable and economically viable electrification for remote villages in Laos and SE-Asia.

Installation and building

- For each location initial surveys by PEP assess the technical and economical viability. Negotiations among stakeholders build the institutional framework, resulting in the required contracts among the actors.

- Then PEP plans, engineers and builds/installs: Penstock, turbine, generator, biofuel generator set, meters to village grid, solar generators and inverters, battery-stacks, household meters, household systems, etc. PEP also sells a "public package" of engineering (Dams, intake channel, village grid, ……) construction and training/coaching to the village energy committee for those elements of the whole system that will be in the ownership of the village.

Training and coaching

During installation, the PEP trains a Village Energy Committee (VEC) mandated by the elected Village Authorities, or directly elected by the villagers. The trainings include

- correct management of the village grid and the village owned infrastructures
- transparent public accounting for the benefit of the village
- organizing trainings and events for discussing and learning about efficient use of electricity in the village
- exploring and initiating productive use of the available energy.

PEP continues to coach the VEC after operations begin.

During construction and installations, at least three Village Technicians (VT) are trained on the job. These Village Technicians will become independent small entrepreneurs. These entrepreneurs will be hired and contracted

- by the Village Energy Committee for operating the grid and infrastructures owned by the village
- by the PEP for operating the movable assets owned by PEP
- by individual users for installing/servicing their own installations.

PEP will provide further coaching and training to the VTs through its franchised service agent, both on technical-operational matters, as well as on business skills for operating the enterprise of VT. This includes the skills to explore how the available electricity can be increased and benefit as many households as possible (issues of equity in the village).

Ownerships

When the system becomes operational, ownership is as follows:

The households own and operate their house-systems

Village enterprises own and operate their small-enterprise systems

The village owns and operates all the fixed assets of the system, i.e.:

- Dams, intakes, channels
- Housing for the hydro-electric power plant
- Fixed structures for solar generators, etc.
- Village grid

The PEP owns and operates all other material that could be theoretically dismantled and moved, i.e.:

- Penstock
- Turbines and generators

- Bio fuel generator set
- Meters to the village grid
- Solar panels
- Inverters
- Batteries and chargers

Reasoning for this split in ownership:

- The unmovable constructions and the grid become a public infrastructure asset of the village. This allows the village to negotiate good deals with the energy providers who want to produce and sell the energy to them. In case an energy provider defaults, the village can easily switch to a new one and does not have to wait for complicated negotiations on ownership transfer of the infrastructures (in case the infrastructure is owned by a defaulting energy provider, it would lie idle until the ownership is renegotiated).

- The movable items become a feasible investment for private investors, as they no longer have to worry about investing in infrastructures over which they will have little control. The movable assets are easier for banks to accept as collateral. Private investments are not tied up in unmovable assets.

- This allows a market to emerge. Villagers can decide to switch to another PEP if they are not satisfied. A PEP can also decide to stop servicing a village if problems with payment discipline arise. The old PEP can move its assets elsewhere, or negotiate their sale to the new PEP. The village can also negotiate a new deal with a new PEP.

So this split in ownership allows for win-win options for all concerned in any conceivable situation. Furthermore public investments into the fixed infrastructures leverages private investments, and vice versa.

Who pays for what when the grid operates?

Households fund their house installations. They may get credits or grants from public sources if they are too poor to afford them, and if they are eligible for public support.

Village enterprises fund their installations for operating their equipment (rice mills, dryers, pumps, coolers, food-processing, communications, etc..).

The village pays for the installations in its public uses, i.e. schools, health posts, temples, etc..

The village pays for its fixed infrastructures, i.e. civil works, grid, etc. It also pays for the required trainings for the Village Energy Committee. The village may get public financial support for being able to afford the “public package” offered by the PEP, i.e. building/installing the fixed infrastructures, and the trainings.

The Village Technician pays for his/her training. S/he may be financially supported by the village in order to ensure accountability to the Village Energy Committee.

The PEP pays for its movable assets. The PEP may get loans and equity from private funding agencies.

Public-private cooperation for investing in hybrid village grids:

Public sources can provide:

- Funds for the village to achieve viable village infrastructures for energy production and distribution.
- Funds for the village for the required trainings and coaching to be able to efficiently manage its fixed infrastructural assets and operate its grid.

Private sources can provide:

- Funds for the PEP to finance the power generation.
- Funds for building the competence and capacity of the PEP to operate the power generation at top reliability.

Operations and financial flows

The PEP operates the power generation.

- It hires/contracts the Village Technician for operating its power generating assets.
- It sells electricity to the village at the points where the power generators feed into the village grid.
-

The Village Energy Committee (VEC) operates the fixed infrastructures and the village grid

- The VEC buys electricity from the PEP, and…
- sells it to the households at the household meters.
- The VEC hires/contracts the Village Technician for servicing the village grid and the infrastructures

The households operate their systems.

- They buy electricity from the VEC
- They pay the Village Technician for servicing their household systems.
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Public concern on the environment:

A stream or river is a natural asset that the public must take care of. Whoever uses it, be it public or private, must divert some of the profit of using the water to allow the public to protect and increase this natural resource, for instance watershed management, catchments protection, ensure residual water in the stream for the fish-migrations, etc. Water rights are therefore sold by the respective public entities to take care of this environmental public concern.
Therefore:
The VEC will divert some amount of its margin for measures to protect the water resources in the catchments area of the tapped streams.

Contractual arrangements

1. Village with PEP
2. PEP with private funding sources
3. Village with public funding sources
4. Between public and private funding sources for coordination
5. Village with public owners of the water source (“water rights”. In Laos this may be the village itself).

A PILOT PROJECT FOR DEMONSTRATING THE OPERATIONS

The above concept shall be demonstrated in a full-scale typical situation. The technologies are all well known. What needs to be tested and demonstrated are the contractual arrangements and the operations of the whole set-up. And it must be shown that this is a financially viable way for public-private cooperation in investments for rural electrification away from the grid.

For this purpose a location has been identified in **Nam Kha** Here a derelict small hydro installation can be refurbished with less costs for the infrastructures, and the solar components and a biofuel generatorset for peak energy consumption then added (see also paper on biofuel generators).

Objectives of the pilot project

The pilot effort in **Nam Kha** shall:

- confirm and establish the logistical requirements for installing and operating the village grid
- confirm and establish the contractual requirements for operating the village grid
- confirm and establish the training requirements for smooth operations at the various levels
- monitor the financial flows and harvest financial data that will allow to better define the parameters for good business plans, for replication of the procedures in other villages.
- act as a demonstration where interested villagers and local officials from other areas can come and look and discuss with their experienced peers in **Nam Kha**.
- provide the information and tested data that will allow to make good investment prospectus for investors in village grids in Lao PDR.

Partners for pilot project

Sunlabob is successfully negotiating with German industries who may have a commercial stake in the success of this pilot, i.e. Entec, Schott Solar, SMA, Lorentz, etc. They will provide the equipment for the movable assets for this pilot. A Memorandum of Understanding with the Lao Organic Farming Association ensures technical backing on the biofuel generator. The source of the financial input for the public infrastructural side is still to be identified.

Expected results of pilot project

The following artefacts are expected to be provided by the pilot project:

- A description of the procedures and the experiences made with them. As a report and as a PowerPoint
- A detailed photo-account of the effort, possibly a video.
- Training curricula, etc.
- A prospectus for investors into further village grids, along with a viable generic business plan that can be adapted to each particular village situation.

- Media coverage.

Scaling-up potential of this pilot project

- At present about 40 locations in Lao PDR are known where village hybrid grids could be built.
- Purely solar-fed grids or combined with other renewable sources than hydro increase this number to fit almost all villages that will not be hooked up to the national electric grid within the next 10-20 years. This is an estimated **200** villages.
- With regard to the national grid, the village grids themselves may also act as "systems-fringe boosters", with their generators remaining operational in order to ensure voltage at the outer reaches of the grid. The already installed local grid with the village energy committee as the sole client is a reduction of costs, that can become an incentive that "pulls" the national grid to these far out villages. Combined with the fringe boosting this allows for increased efficiency of electrical coverage.

Financing the pilot project

For details refer to attached budget

	Investments
30.000 USD	Infrastructural costs for dams, intakes, channels, grid, etc. These are relatively low, as the already village owned infrastructures for the derelict hydro plant only need partial refurbishing
30.000 USD	"Soft" investments in the form of trainings and coaching for company engineers, local technician and entrepreneurs, plus the demonstration and media efforts.
90.000 USD	Total costs for the movable assets
	Financial assumptions to be verified by the pilot project
8.000 USD	Projected returns per year from monthly collection of fees
800 USD	Projected operational costs per year