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Technical Paper

**OFF-GRID SMART MICRO ENERGY SYSTEMS: IMPROVED
DEVELOPMENT & OPERATING MODEL AND GUIDELINES**

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Acknowledgement:

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Forward

The purpose of this study is to synthesise the lessons learnt from the Community Power Centers (CPC) piloted by UNIDO in Kenya, Uganda and Tanzania, and other similar projects, in order to develop a viable and sustainable business model that is acceptable for entrepreneurs and offers off-grid energy access solutions to remote communities. This model needs to be encased in a set of practical guidelines that will facilitate the delivery of many more sustainable energy systems within East African Community.

The current technical paper is an excerpt of this study report prepared for the Expert Group Meeting in Kampala, 22-23 October 2015. Importantly, the study report will be published as an official UNIDO Guidebook for the use of entrepreneurs and investors, as well as local governments and communities, for the successful development, implementation and operation of off-grid energy systems for productive uses. Contained within the guidelines will be critical success factors and associated checklists that will become prerequisites for the sign off of all future off-grid energy system projects by entrepreneurs and investors.

DRAFT

1 Revised Community Power Centre model design

Based on the current knowledge on mini grid and the experience of the consultant with the operation of electricity distribution companies, an improved delivery model is recommended and is now presented in detail.

1.1 Basic approach development

Following an extensive review and analysis of the comprehensive evidence gathered about the creation, operation and economic sustainability of Community Power Centres (CPC's) across Uganda and Kenya and other literature sources, it is necessary to propose: firstly, a set of *firm principles* to be applied in the future; and, secondly, a *revised business model design approach*. In this way it will be possible to avoid the past mistakes while ensuring the success of *off-grid energy systems* in the future.

1.1.1 Firm foundational principles

It is strongly recommended that to ensure economic sustainability in the future with *off-grid energy systems*, certain principles must be strictly adhered to as follows:

1. Locations to be served must be selected for the right reasons that include a genuine and defined need for the productive services and economic benefit of a *off-grid energy system*. Such locations must also not be receiving grid electricity for at least another 10 years.
2. A formal business case at a level suitable for submission to a commercial bank to secure loan capital must be prepared and signed off by all responsible stakeholders and clear certain benchmarks, for all future *off-grid energy systems*.
3. A commercial approach as opposed to an informal aid styled approach must underpin and drive the *off-grid energy system's* business model design, set up and operation. This has two important repercussions, namely:
 - The first priority market to be targeted and necessary to justify sales, and economically anchor a new business with regular income and a robust business case for investment will be the commercial and productive energy market. In other words where energy is used for economic activities such as milling, hairdressing, product manufacture, communications or other commercial income and livelihood generating activities. Residential and institutional market development must be a secondary driver and picked up once a robust commercial local energy market has been substantiated.
 - The *off-grid energy systems* will be funded, set up, operated and 'held to account' for business and service performance according to customary commercial practices. The procurement of energy production and supply infrastructure will be done according to legally binding tenders and contractual supply agreements. It will also involve clear *off-grid energy systems* ownership rules that must have a singular point of reference, role clarity between the various formal stakeholders with clearly defined accountabilities, regular and consistent results monitoring, performance management; and, financial, contractual and technical discipline.
4. Financial discipline must include the provision of conventional 'returns on capital' used to create the *off-grid energy systems*, formal loan agreements and with a minimal level of collateral by the local community or entrepreneur owner. Such financial arrangements may enjoy a subsidy via a developmental or Government agency although some return on capital must become the accountability of the operators of the *off-grid energy systems*. Without some financial obligation and commercial business commitment, experience demonstrates, failure usually

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- follows. All investment parties will need continued involvement to ensure performance and operational sustainability.
5. The series of activities, under off-grid energy systems design, set up and operation, described under the Revised Business Model section below must be adhered to and conducted as specified.
 6. An *off-grid energy system* must aim to meet all the energy needs of commercial enterprises and homes within the defined geographical area of supply and jurisdiction. This to include electricity, and thermal energy needs via fuels such as biomass briquettes, biogas and clean cooking fuels but excluding transport fuels.
 7. For all larger (>150kW) *off-grid energy systems* there should be two separate yet complementary and related business activities, namely:
 - The first business entity is what may be described as the wholesale supply of energy/electricity. This will consist typically of a reliable source of electrical energy produced from technology selected from a range of possibilities. It may be a hybrid 'power station' consisting of wind, PV and hydro generation plus a back-up gen set or a substantial hydro generation plant used in association with a PV or wind generation facilities. In addition, to meet thermal energy needs there will be a local charcoal supply or a biomass briquette supply for smokeless stoves for cooking. For hot water provision solar water heaters may be deployed. The wholesale supply of energies is regarded as a stand-alone business requiring high level technical, business and offsite support skills and resources. This business requires very different skills and resources to those necessary for the local distribution and sale of energy. For electricity supply for example, a 'plug in and supply' type of operational paradigm will ensure lower risks, consistency of supply and professional maintenance and reinvestment in plant and equipment. It is proposed that a formal supply and service agreement be set up between the 'energy wholesaler' and the local energy marketer and distributor.
 - Local energy/electricity/services marketer and distributor. This separate business entity will handle local sales, distribution, revenue collection and customer service activities. It will also embrace a level of technical support to customers, energy equipment repair and the installation of energy systems such as basic electrical wiring, meters and solar water heating system installation. Local community members and/or entrepreneurs/s can play a greater role in this particular element of the *off-grid energy systems* and ensure efficient supply of the products and services to local businesses, schools, clinics, shops and homes. With appropriate training and accreditation a range of new local sustainable livelihoods may be created to directly support the operation of the *off-grid energy system*.
 8. An *off-grid energy system* must at all times provide a professional energy supply service including electricity supply that is fully comparable to a grid electricity supply. The products of an *off-grid energy system* must never be permitted to be judged as second best, as most end users will have knowledge and experience of grid power. To achieve this it is important that the *off-grid energy system* has adequate technical and market penetration energy supply critical mass from the outset.
 9. Community and stakeholder liaison/agreement plus thorough local situational research are essential activities as precursors to any *off-grid energy system* design and business case. These activities / methodologies used and results obtained must be clearly stated in all supporting *off-grid energy system* project documentation. Critical matters to be researched, defined and quantified include:
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- Commercial customer power/energy and end use equipment needs.
 - End user energy equipment specifications.
 - Supply costs, terms and conditions acceptable to commercial and household potential customers.
 - The affordability of the *off-grid energy systems* products and services
 - Expectations of customers, particularly commercial customers.
10. To ensure that the benefits of modern energy supply are fully leveraged for the creation of new or expanded economic activities and livelihoods, the *off-grid energy system* design and business case must always be coupled with other enablers for economic growth. Associated business development enablers such as access to markets, business skills training, communication networks, marketing facilities and access to micro credit facilities must also be harnessed or provided by other relevant stakeholders that are held to account to operate against declared targets and performance measures. Just as the owner/s and operators of an *off-grid energy system* must be held accountable for the successful supply of modern energy to rural communities, so too must local and regional economic development agencies working in partnership with them for the creation of new sustainable livelihoods.

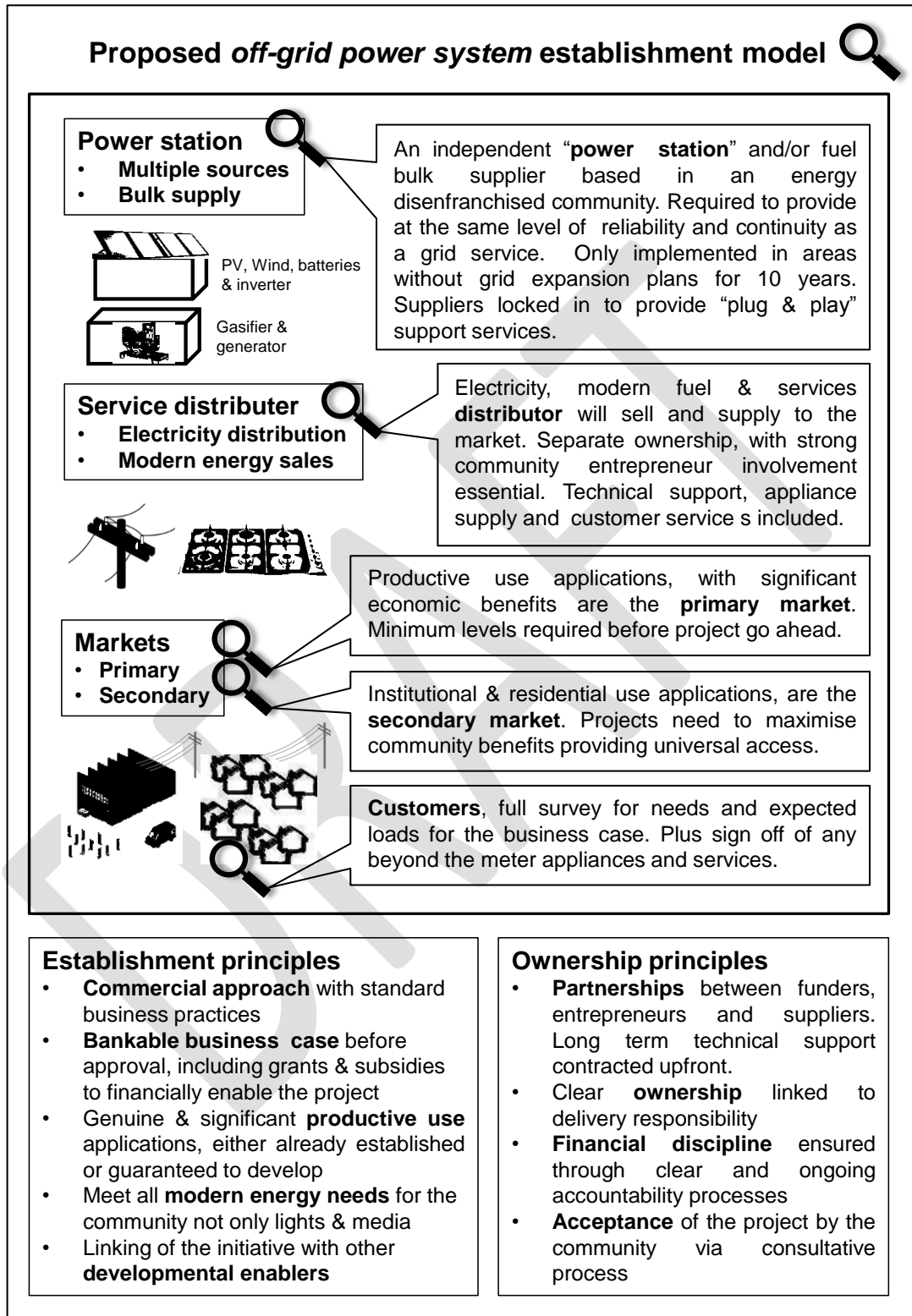
Key principle:

The overarching principle that cannot be over emphasized is the vital importance of establishing and operating future off-grid energy systems as much as possible as viable commercial business undertakings.

A proper balance between sponsored seed funding and commercial funding will be essential. Too much soft development funding and aid will weaken the prospects of economic sustainability. The more future *off-grid energy systems* can be operated by local business entrepreneurs based on defined local energy usage needs with paid for services the greater their chance of survival and the creation of lasting local economic developments and new livelihoods.

1.1.2 A revised business model design approach

The critically important components and activities of the revised *off-grid energy system* Business Model are described below:



The enactment of *off-grid energy systems* on this basis requires a much more disciplined and commercial approach as set out in the next section.

1.2 Project development stages

Three stages of project development are recommended and described. It is important to note that the first two stages will require high levels of external facilitation a role that UNIDO or other developmental entities are likely to undertake with appointed project development facilitators. By the last stage it is envisaged that the role of external facilitation would have decreased and be under taken by project investors only.

1.2.1 Off-grid energy system – design

This formative stage must provide all the necessary information to enable proper pre planning and the validation of a robust *off-grid energy system* design that subject to full and efficient implementation will fully meet the needs of a designated location of energy supply. It must consist of a wide range of demand and supply side investigative activity including necessary pre-research, situational intelligence gathering in the geographical area to be supplied, commercial and household customer needs and aspiration interviews, comprehensive local existing energy market appreciation, competitor reviews, affordability measures, environmental and safety requirements. From a supply side perspective pre research must involve a specification of gross energy needs, locally available energy sources that may be harnessed, a systematic matching of various energy production and supply systems to local circumstances and needs, cost evaluations and the selection of best in class and fit for purpose technical solutions for the energy wholesale part of the *off-grid energy system*.

Without accurate qualitative and quantitative information and full validation of an *off-grid energy system* planning and design assumptions the risks of failure intensify.

It will be helpful to have a framework to guide the necessary activities of this stage. It is recommended that the framework has two sets of factors to be considered as follows:

Supply side requirements: This relates to the wholesale supply of energy.

These are all the necessary wholesale energy provisions based on a qualitative and quantitative assessment of the energy needs within the proposed *off-grid energy system's* geographical area of supply. It will also involve the economic and technical appraisal of energy supply plant, particularly for the local 'mini power station' to ensure robust and fit for purpose equipment selection and specification. Plus the required back up services and fuel supplies.

Demand side requirements: This relates to the marketing, distribution and revenue collection for energy and related services

These will involve local area supply circumstances, types and numbers of customers, their needs, locations and so forth. Much of this information will be required to be able to size the amount of energy that will ultimately be sold in the area, to which types of user and for what end use applications. Investigation needs to cover firstly for productive usage followed by the residential market that depends on income levels and affordability matters. All this information will be required for the business case and the *off-grid energy system* marketing and revenue plan.

The essential activities and outputs at this initial stage in the formation of an *off-grid energy venture* will be as follows:

- *Pre-feasibility study.* This will look at the business and economic development potential of a defined geographical area. It will also ensure that grid electricity will not be planned for the area for at least another 10 years. It will consider the likely investment costs versus income and whether a viable commercial *off-grid energy system* can be created. The other important factor that should be assessed at this stage is local capacity in terms of suitable people to operate and/or own the *off-grid*

energy system venture. A local champion, entrepreneur or mandated leader to successfully patronize the *off-grid energy system* should also be clarified.

- *Detailed feasibility study*: This will involve comprehensive data gathering on the ground in the community and at Provincial and Government level. Necessary regulatory and licensing matters must be stipulated. The precise energy services and products to be supplied need to be specified together with a cost benefit appraisal and forecast of revenues, operating cost margins and surplus (profits). A critical part of this work is the determination of electrical use and modelling of overall after demand diversity loads to specify suitable plant sizes technically from a generation perspective. The plant construction, installation and operating costs must be quantified together with all relevant maintenance and operational staff costs and needs. The scale of fees or tariffs and revenue collection methods must be specified. Affordability levels and disposable income levels in the local community must also be shown to validate any marketing and sales assumptions. All the key stakeholders must also be listed having been consulted. There will need to be a description of roles, deliverables and obligations to be met by each of the stakeholders.
- *Business plan and business case*: From the detailed feasibility study work it will now be possible to formulate a detailed business plan and business case. The business case must be suitable to be submitted to a commercial bank for the raising of loan capital to set up the *off-grid energy system*. Ownership, key management and operational personnel must also be identified and fully described. Investors look not only at the market potential, the technical and financial numbers but more particularly at the quality of the people who will be involved to make the venture a commercial success.

1.2.2 Off-grid energy system – set up

Should the decision be taken to begin implementation, then a series of set up activities is required.

Step one – Sign offs and approvals.

- Before embarking on actual fund raising there is a need by all major implementation stakeholders, especially the community and local entrepreneurs to sign off on the business plan and commit to mutual responsibilities for implementation and on-going operation.
- Political and technical approvals if required such as licences to operate.
- Project funding from a donor, banking and community/entrepreneur perspective, with guarantees through to full implementation.

Step two – Procurement

- Equipment specifications need to be prepared for all parts of the *off-grid energy system* including any end user equipment. These specifications must be technically correct and include quality requirements, guarantees and long term support matters. A number of these will need sign off by more than one party e.g. end usage equipment will need to be signed off by the project beneficiaries.
- Tendering and adjudication, under the control of major funders in the project.
- Service level agreements with wholesaler energy suppliers and other longer term service providers.

Step three – Delivery/construction/installation

- Site set up for installation, may require a local office, buildings etc.

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- Installation of all *off-grid energy system* components by the suppliers.
 - *Off-grid energy system* commissioning.
 - Throughout this step and the next it is imperative that independent and accountable project managers are utilised to ensure quality control and payment only for work correctly completed to specification.

Step four – Proving and training

- Contracts will be required following commissioning to operate the *off-grid energy system* for a proving period of 3 months.
- Concurrently on job training of future owners and operators to be completed. Naturally this will include the recruiting of the necessary staff upfront. In fact inclusion of the operational staff in the construction/installation phase will be an added benefit and income for the community.
- Full operational functionality to be proven before suppliers are released including performance management systems, reporting and financial controls going forward.

1.2.3 Off-grid energy system – operation

By this stage in the steps in creating successful *off-grid energy system* the point has been reached when detailed plans, legal supply agreements, commercial contracts and funding agreements have to be enacted. This is when project plans hopefully become reality and the owners and operators of an *off-grid energy system* are engaged in the time consuming and challenging activity of operation.

Before getting into the detail of the activities of this stage some important words of caution are necessary. Even the best laid plans rarely are implemented completely as written. Unexpected situations or events will always arise so it is of vital importance to have robust mechanisms to monitor such eventualities, take corrective action and remain on course. An *off-grid energy system* project implementation plan with timelines, all the essential roles and delivery outputs specified with clearly defined responsibilities will be essential for this stage. It will be crucial to have efficient communication channels established and a regular series of performance evaluation meetings scheduled with all the stakeholders. It will also be important to have established the various mandates of people involved and who the ultimate 'boss' is and who will be held fully accountable for the success or failure of the *off-grid energy system*. Ultimately committees deliver little. It is generally a single leader who gets things done otherwise responsibility can quickly be shelved to others and dissipates. Also, what gets measured generally gets done. These few pre-emptive considerations described in this short paragraph will largely determine the success or failure of this third and final stage in the creation of the *off-grid energy system*.

Key steps will include:

Step One – Ownership and management structures

- Setting up of management in line with agreed ownership models for both the supply and demand side activities.
- Agreements on ways of working, dispute resolution, performance enforcement and annual pricing reviews to be prepared and signed off.

Step two – On-going operation

- Sign off by the new owners accepting full operational responsibility and release of the contractors after the three months proving period.

Step One – Ownership and management structures

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- *Off-grid energy system* operation as per service level agreements, customer service, revenue collection etc.
 - Regular reviews by the agreed management structures will need to include management reports.
 - Supply of longer term support and other services as part of the business design e.g. plug and play on any electricity generation equipment failures.

1.3 Ownership

As has been already intimated, this is a most critical aspect of ensuring future success of *off-grid energy systems*. Together with leadership activities it requires a particular focus and emphasis. It concerns who owns the *off-grid energy system*, who provides the capital and equipment in order to create and operate it; and, particularly who will hold the prime responsibility for the success or failure of such energy ventures.

The existing CPC's ownership approach consisted of providing funds and energy equipment to a local community committee that then had jurisdiction over the operating arrangements, income generated and the appointment of a manager. These rather loose and ill-defined ownership arrangements appear to have had very little accountability attached to them. From the extensive evidence of CPC failures such ownership arrangements have clearly not worked effectively or been fit for purpose. Fair to say in the normal commercial world such situations would never transpire; hence matters can be no different in the introduction of an *off-grid energy system*. In this section we propose alternative recommendations about ownership, who should own them and how such arrangements may be enacted.

1.3.1 Importance of "Ownership"

When referring to ownership it is important to describe what this means in the context of enabling sustainable *off-grid energy systems*. We will return to the financial and legal implications involved with ownership in a moment and various models of ownership that can be deployed for an *off-grid energy system*. However, firstly it is essential to emphasise other important and necessary aspects of ownership. These include the following:

- Ownership involves also personal liabilities and responsibilities to properly manage what is possessed.
- Ownership involves accountability to other owners, customers and stakeholders in the business.
- In competitive economic situations where scarce resources (and money) are involved, ownership generally requires positive performance, economic success and an assurance that the venture is in 'safe hands'.
- Even minor or partial ownership of a 'stake' in a business venture is highly motivational for those involved to succeed.
- Ownership in this context is a reciprocal relationship with rights and obligations inferred to the owner by stakeholders and customers and vice versa whereby customers, for example, must also observe a range of obligations to the owner/s. These include paying for energy supply and using such services safely.
- Ownership, even across different cultures, necessitates personal risk, reputation and 'good standing' among stakeholders.
- Ownership also generally necessitates the holding of requisite skills, knowledge and or performance track record in the particular business involved. Investors and stakeholders in a business venture are generally going to call for such skills before investing and granting any degree of business ownership.

In this sense ownership generally elicits from those possessing it a greater degree of personal accountability, care, attention to detail, persistence to succeed, desire to grow the venture, to fully meet and even exceed personal obligations and thereby fully commit to the achievement of the vision of an enterprise. As well as these indisputable benefits of ownership for the success and sustainability of enterprise it is important to acknowledge that a more singular rather than plural ownership also generally leads to greater success.

The old saying applies that 'The buck must stop somewhere' and that ultimately an individual must hold responsibility for success or failure.

Community Committees that were the ownership model for CPC's have little personal individual accountability for the performance, success or failure of the energy supply venture. Culpability unless it can be traced to an individual or very small group of people, rarely is possible. Instead, plural committee accountability structures enable no one to be held responsible for failure. As well as this the matter of competency and having the necessary skills to succeed with a complex technical business such as energy supply must also be questioned about the CPC Community Committees being expected to manage such matters?

Thus proper ownership arrangements in the terms described above must be regarded as a critical success factor for future *off-grid energy system* ventures if they are to be sustainable energy businesses.

1.3.2 Recommended Ownership Arrangements

Multiple ownership

There are two important dimensions and dynamics involved with practical notions of ownership. Firstly, the amount of ownership, whether 100% or 10% for example. Linked to this is how such varying levels of ownership are possessed, recorded, managed and even traded? There needs to be a 'share register' and a simple form of 'share capital' created at point of departure for the *off-grid energy system*. The other dimension is time and that levels of ownership in an *off-grid energy system* possessed by different parties can vary over time. Quantities of shares can be held in reserve for example to be earned over time by the achievement of defined performance targets and deliverables. The level of share ownership by different parties can also reflect their contribution and importance in influencing the success of the venture in the future.

Drawing on these two simple and flexible concepts of amount of ownership represented by a percentage of 'shares'; and, time, we can now consider a range of 'fit for purpose' ownership possibilities to ensure successful *off-grid energy system*'s in the future. Such possibilities include:

- As part of the venture set up a simple issue of *Off-Grid Energy System* Shares be established with a share register. This can be lodged with a firm of lawyers and can be a simple administrative yet legally binding arrangement. The conditions afforded to shareholders will need to be stipulated as to whether they also carry jurisprudence over the policies and affairs of the *off-grid energy system* business venture. A simple arrangement could for example consist of 100 notional shares either with or without voting rights for stipulated purposes.
- A number of key people, each having a direct influence on the success or failure of the business should be able to own a portion of the business. Key shareholders will include the funding bodies whether banks or development agencies such as UNIDO. In addition major plant and equipment suppliers should also hold a small number of shares.
- A Community Committee may also hold a number of shares although this is not regarded as being essential. See "Customer and Community Consultative Group" below.

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- Government electrification agencies or Small Business Development Agencies may also wish to hold a portion of the shares.
 - Staff who work in the *off-grid energy supply venture* may also hold some shares in the business and these may be awarded related to the successful achievement of business targets over time.
 - The most important and vital shareholder however must be the operator or local entrepreneur who will lead the venture to success and sustainability. Although in the early history of an *off-grid energy system* the local entrepreneur may only be able to hold (afford) a limited number of shares, over time and related to successful performance the aim should be for this person to greatly increase their level of ownership.

Once the rural energy business has been running successfully for a period of time the entrepreneur should be able to buy the shares of other stakeholders such as major equipment suppliers and development funding agencies. Indeed one of the litmus tests of sustainability will be when the business is owned and operated successfully by a local entrepreneur and business leader without major support from others.

Ownership and leadership

If we are to assume that ownership must also have a high degree of individualistic accountability linked to business performance then how can this be achieved with *off-grid energy system ventures* and how can it be allied with the other critical success factor of business leadership. The following appropriate ownership enabling arrangements are proposed:

- In the *off-grid energy system* set up stage a potential leader and entrepreneur to run the energy enterprise needs to be identified. Ideally this should be a local individual.
- Appropriate selection and recruitment processes need to be followed by the project development facilitator. A package needs to be offered to such a recruit that includes an element of profit sharing and ownership of shares. Full training and business development mentorship must be provided by or via the project development facilitator.
- Ideally the local entrepreneur will need to invest some personal money or collateral into the *off-grid energy system* business. Where the individual is without finance or other collateral then other innovative approaches need to be deployed, such as:
 - Shares in the business in lieu part of salary
 - Shares as performance bonus payment/reward
 - Subsidised personal loans
 - Development agencies providing surety for high potential but poor entrepreneurs
- Soft loans and funding by development agencies need to be reflected in the accounts of the *off-grid energy system* business. Whether they need to be repaid or written off will depend on the policy of the funding agency. However, the true costs and investments necessary for the *off-grid energy system* need to be recorded and made transparent to stakeholders.
- Formal bank loans extended (as part of the necessary venture set up capital) to create the business will need to be repaid and will become the responsibility of all those holding shares in the business.

Community Ownership

In terms of Community ownership and Community Committees these probably do not need any formal ownership of the *off-grid energy system* Business. What is necessary however is to have a properly formulated Customer and Community Consultative Group that meet regularly with the *off-grid energy system* Management, Investors (such as UNIDO and Banks) and major suppliers (such as the wholesale energy supplier). Such a group must have a proper constitution and be mandated to regularly receive performance reports from the *off-grid energy system* management, receive reports on any major developments impacting customers or the community and to place complaints or other problems in front of the group for resolution. Customer and community representatives must be appointed and publicised throughout the local community and with all relevant customer groups. Their role will be to act as independent recipients and communicators of all energy supply performance and complaints related matters to the *off-grid energy system* business and the community.

1.4 Sizing and viability aspects

After ownership, perhaps the second most important aspect relates to the size and viability of the *off-grid energy system* introduced into a community. For agencies, such as UNIDO, to warrant the resources needed to bring about the establishment of an *off-grid energy system*, it is imperative that the socio-economic returns will be sufficient.

The fundamental considerations in determining the size of a project in terms of how much energy will be supplied (and thereby needed to be produced by the wholesale 'plug and play' part of the business) together with the scale of an *off-grid energy system* business in terms of the distribution network will be as follows:

- a. The defined geographical area in which the business is planned to operate
- b. The number of existing potential commercial, institutional and household customers
- c. The energy requirements (i.e. amount of electricity and when it is needed during each hour of the day, day of the week and week of the year) of each of the market sectors such as commercial and household.
- d. Any planned new business or other potential energy users entering the area
- e. Forecast energy demand each year for the next 10 years

It will be the summation of data under b, c, d and e above that will determine how much energy will need to be supplied. This information linked to item a will also determine the overall scale of the proposed off-grid network.

Clearly there is not a magic number, rather a number of factors need to be considered and addressed as part of the business plan development.

Rule of thumb sizing guidelines

In all cases it is important to be able to estimate the typical "ball-park" size of the electrical supply needed for a village or community upfront in the process. Electrical system sizing always relates to two factors:

1. **After diversity maximum demand (ADMD)** – measured in kW, would be less than the full installed equipment rating or customer supply point, by multiplying with a statistical probability factor. For example, in a household, all the LED lights, refrigerator, TV and charging devices may add up to a total load of 0.4kW, yet the statistical probability of them all being on at the same time and in all similar houses would only be 40%, giving a ADMD of $0.5 \times 40\% = 0.25\text{kW}$. These ADMD loads always relate to a specific time of the day with either a day high or early evening high.

- Annual energy usage** – measured in kWh, would be the total of all energy likely to be used by the installed equipment or customer supply point in a year. For example, in the poor subsistence household adding up all the usage over a year it would be around 1,056 kWh.

For typical rural/community applications the adjacent table provides the basic building blocks:

Socio economic segment or activity	ADMD and usage assumptions/unit			
	Energy pa kWh	ADMD Day kW	ADMD Night kW	Installed kW
Affluent, larger households	4,416	0.21	1.43	5.72
Average income medium households	2,376	0.10	0.66	2.64
Poor subsistence small households	1,056	0.06	0.39	1.54
Police stations, government offices	3,942	1.35	0.14	3.00
Schools	5,256	1.80	0.18	4.00
General dealers	3,942	1.35	0.54	3.00
Restaurants	5,256	1.80	1.80	4.00
Rice mill	26,280	6.75	0.68	15.00
ITC	6,132	1.10	1.10	2.00
other	15,330	2.00	0.20	5.00
other	30,660	4.00	0.40	10.00
other	45,990	6.00	0.60	15.00

Some typical community examples could be:

Example 1					Example 2				
	#	kWh	Day kW	Night kW		#	kWh	Day kW	Night kW
Affluent, larger households	20	88,320	4.3	28.6	Affluent, larger households	2	8,832	0.4	2.9
Average income medium households	120	285,120	11.9	79.1	Average income medium households	20	47,520	2.0	13.2
Poor subsistence small households	250	264,000	14.5	96.5	Poor subsistence small households	40	42,240	2.3	15.4
Police stations, government offices	4	15,768	5.4	0.5	Police stations, government offices	2	7,884	2.7	0.3
Schools	2	10,512	3.6	0.4	Schools	1	5,256	1.8	0.2
General dealers	5	19,710	6.8	2.7	General dealers	3	11,826	4.1	1.6
Restaurants	2	10,512	3.6	3.6	Rice mill	10	262,800	67.5	6.8
Rice mill	10	262,800	67.5	6.8	ITC	1	6,132	1.1	1.1
ITC	1	6,132	1.1	1.1	Total		392,490	82	41
Total		962,874	119	219	Average load factor/generation usage		55%		
Average load factor/generation usage		50%							

In the first example the highest loads of 219kW are expected to be in the evening, with an average usage of the generation equipment at 50%. In the second the highest load is in the day at 80kW and a 55% utilisation of the generation equipment.

Measure of project size

Rather than just an electrical rating (e.g. 50kW), far better measures will be related to the volume of community impact, suggested as:

Productive use factor = sum of the annual turnover for businesses impacted/grown through the supply in local currency. This number can be obtained by surveying the businesses that will utilise power from the *off-grid energy system*. Guaranteed growth due to the provision of modern energy needs to be added to determine the annual turnover of each, e.g. a dairy with expanded operation in terms of litres per year and expected sales price.

Residential use factor = number of homes that will receive modern energy such as lights and media times the average income for the area per household in local currency.

Combined total level of economic activity impacted/supported by the *off-grid energy system* = Productive use + Residential use

The benefits of measuring projects on this basis when evaluating a number of different potential *off-grid energy system* projects for selection to proceed would be:

- Prioritisation of projects through comparison to determine which will provide the highest returns and should be invested in first.
- Ensure a balance of productive use versus expected secondary institutional and residential use, which should be less.

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3. An indication of what the overall economic multiplier will be by dividing the economic activity by the *off-grid energy system* cost.

Indicators of size example

For example, a project in a community that consists of 200 households that could utilise the *off-grid energy system*, plus off peak usage by the community for residential lights, TV, refrigeration type applications. The generation capacity needed would be around 150kW (3amps/house on average). For the example we can assume an annual household per capita income level of \$300/year and 5 persons per household.

Residential use factor = $200 * 5 * 300 = \$300,000$ residential expenditure per year.

Minimum productive use needs to be at least at a similar level.

Combined total level of economic = \$600,000/year.

Off-grid energy system, project cost (@ \$2,000/kW) = $150 * 2000 = \$300,000$

Multiplier impact = $600,000 / 300,000 = 2$

Minimum size, modularity and provision for growth

The multiplier impact, for example a ratio of 2 above, can then be compared to other projects. Of course, the smaller the project size in terms of businesses supported and households supplied, the more the set up costs will inflate the *off-grid energy system* cost and shift focus to the bigger projects and cheapest sources of power.

While these methods enable projects to be compared there is no indication/guidance on minimum size of projects to be viable. The following recommendations are made as a basis from which project developers can work:

1. Impact on businesses with a guaranteed annual turnover and household expenditure of at least \$200,000 per year.
2. A ratio of at least 2 between the economic benefit to project cost.

Lastly, there is a need to plan modularity and the potential for growth into projects. For example the mini power stations can be procured in multiple sizes such as 50, 100, 150, 200, 300, 500 kW. This would benefit both the lowering of procurement costs and facilitate the exchange of one unit for another should the market for the energy/electricity grow beyond the supply size.]

1.5 Stakeholder requirements and interactions

This section covers the identification of key stakeholders, role players and clients/potential energy customers, plus the issues that will need to be discussed with stakeholders.

Definitions

Before addressing the matter of issues that need to be clarified with stakeholders, players and clients of an *off-grid energy system*, it will be helpful to state some relevant definitions. It is very important that everyone fully understand what a stakeholder is versus a player and versus a client for the purpose of properly establishing sustainable *off-grid energy system's* in the future.

Stakeholder

Those having a direct 'stake' in an *off-grid energy system operation*. Such stakeholders will include investors, UNIDO, local energy policy makers and regulators, the local community committee and the owner and operator of the business. Local socio economic and livelihood development agencies and NGO's will also be important stakeholders to be addressed. All these people and types of roles and entities have a direct commitment to the success or failure of the venture.

Role Players:

These may include equipment, energy production plant/system and appliance suppliers, installers and contractors. Suppliers of fuels to the *off-grid energy system*. Others may include such activities as training, accountancy and technical service providers. The local media will also likely be an important player in supporting the business.

It will be important to ensure that all role players are fully cognizant of the vision and mission of the *off-grid energy system* and act accordingly in a supportive manner.

Clients:

These will be customers and recipients of the products and services provided by the *off-grid energy system*. These must be classified and differentiated to ensure all the different types of clients are properly identified and engaged. In terms of consumers there will be a range of commercial (or 'productive') users ranging from larger productive entities such as small factories or food processing plants ranging down to smaller users such as hairdressers and sewing shops. There will also be the residential market sector with varying household sizes and income levels. Another market sector will be what may be described as institutional consumers such as the local schools, clinics, police and offices of local government agencies. All of these many types of market sector consist of users or clients for the services of the *off-grid energy system*.

Each of the above three major categories of stakeholders, players and clients must be identified, engaged and a range of specific issues for each group discussed, clarified, agreed and quantified. These are now described below:

Issues with Stakeholders

Typical issues to be clarified and agreed with stakeholders will firstly be the precise role that each will play with the *off-grid energy system* and what the mutual obligations will be? For those who invest in the *off-grid energy system* a key mutual obligation will be how long the lender is providing capital and on what terms and over what time period. For the *off-grid energy system* an agreed repayment or payment of dividends will need to be agreed and written up. For an organization such as UNIDO similar financial arrangements may be necessary plus stipulation of a range of other deliverables such as energy supply service levels for the local community, number of livelihoods created and number of learners with access to the internet. For local energy regulatory bodies' compliance with relevant rules and regulations will need to be understood and the *off-grid energy system* committed to adhere to them.

A very important group of stakeholders in addition to those funding, owning and operating an *off-grid energy system* will be members of the local community. The *off-grid energy system* must at all times ensure it provides products and services that are designed according to the needs of local customers, the local market place conditions and the needs of the community. Just as the business will have a number of fundamental obligations towards its customers and the communities in which it operates, so too the local community committee and leadership will have necessary obligations toward the *off-grid energy system*. These will include granting the *off-grid energy system* local jurisdiction and control over its affairs, access to premises, safety of personnel and no disruptive interference by community members. For security purposes all the employees of the business must have company identification when entering customers premises and such arrangements must be widely publicised throughout the community.

Issues with Role Players

For suppliers to the *off-grid energy system* for example the major issues to be addressed will be the suitability of their products and services for the needs of the business, their competency to provide the services they offer and having proper commercial procurement and necessary legal safeguards in place for any failures or deficiencies in delivery. For

most suppliers there will need to be clear and proper terms of supply and payment. Performance management of suppliers and how this will be performed must be clarified and understood between both parties. How any disputes that may arise between the *off-grid power system* business and significant other role players should also be agreed upfront where ever necessary.

Issues with Clients

The major group of clients of an *off-grid energy system* will be its customers. Whether industrial, commercial, institutional or residential customers the *off-grid energy system* must ensure that it has consulted with a representative sample from all customer categories. Such consultation in addition to quantifying the number and location of each category of customer must also seek to fully understand the customer's needs for energy, what they will use it for, the quality of such supply to meet their requirements, affordability and how it will be paid for. Types and levels of customer service must also be discussed with customers and the expectations of each customer group fully mapped. How the energy and services are to be provided, what guarantees customers will require, necessary customer education for the safe use of the energy – these and other important issues must be painstakingly discussed and clarified with customers.

When it comes to institutional customers such as schools and clinics different types of expectations and levels of service will be required. In the case of a clinic for example uninterrupted electricity supply may be a fundamental necessity for certain agreed periods of the working day. Schools may also insist on uninterrupted power supply for certain time periods to enable certain types of schooling or the use of internet or distance learning.

Once all these various needs have been mapped and clarified with customers then appropriate operating routines can be established by the *off-grid energy system*. Where unavoidable constraints to energy supply exist these can be explained to customers and their expectations professionally managed.

1.6 Pre-requisites and critical success factors

Pre-requisites and critical success factors for any organisation involved with promoting or supporting the setup of *off-grid energy system* without which, project investments should not be allowed.

There are twenty critical success factors (CSF's) and pre-requisites that must always be clearly demonstrated to justify an *off-grid energy system* project investment. Most of the following CSF benchmarks must be addressed in the 'business case' that will need to be submitted to UNIDO and other foundational investors and stakeholders by a local entrepreneur or other entity wishing to create an *off-grid energy system* and requesting funding. They are recommended to be as follows:

#	Critical success factors (CSF's)	Tick
1	A minimum of a 50% self, local community or <i>commercial bank funding</i> for capital requirements for the proposed <i>off-grid energy system</i> . Agreement with all stakeholders that the <i>off-grid energy system</i> will be established and operated on commercial terms and operating conditions	
2	That there is <i>clarity of vision and goals</i> . These to include matters such as <i>off-grid energy system</i> ownership, achieving specified implementation timelines and costs, proper staff training and employment terms and conditions, plant maintenance service agreements with suppliers, trained technical support staff, customer service levels, revenue collection standards and the systematic	

	achievement of realistic performance targets	
3	Credible <i>off-grid energy system entrepreneur or champion</i> . In almost all ventures success or failure depends largely on the person who initiates, develops and then leads the business. Passion, relevant skills, integrity and legitimacy with all stakeholders are typical pre-requisites that define such individuals	
4	All <i>procurement performed professionally</i> . In other words against written stipulated requirements, different competitive quotations and prices obtained and the credentials of suppliers and subcontractors always inspected together with relevant accreditations. Once equipment authorised together with a supplier then formal supply contract (this can be a simple document signed by both parties) detailing supply, receipt and payment terms.	
5	<i>Stakeholders, actors, roles, obligations and benefits</i> must be fully identified and specified	
6	Substantive <i>commercial market demand identified and demonstrated</i> . Such energy demand from productive commercial activities in local communities must always provide the bedrock on which to build commercially sustainable <i>off-grid energy systems</i> . In this way their future success is greater while also driving to meet the other primary objective of creating new economic activities and livelihoods	
7	<i>Ability to pay and affordability</i> of <i>off-grid energy system</i> products and services for the designated customer categories. It is vital that details are described and validated as to how payment for energy and other services provided by the <i>off-grid energy system</i> will be made by customers	
8	There must be an <i>acceptable tariff structure and revenue collection</i> system including metering where appropriate.	
9	All choices of <i>energy sources</i> , energy production and supply technologies must be <i>properly evaluated and assessed</i> in terms of costs, technical durability, operational reliability and suitability for purpose and the environment where they will be operating	
10	<i>Resource fuel</i> must be known to be available, quantified and where necessary <i>supply contracted</i> . All sources of energy such as sun light hours, seasonal wind sources, biomass materials, local river flows for mini hydro and all other sources such as vegetable oils must be thoroughly researched and where necessary annual supply contracts put in place.	
11	<i>Appropriate suppliers</i> must be sourced and specified. Only accredited and qualified quality contractors and suppliers to be employed. References, appropriate accreditations and their track record must be validated. Formal legal supply agreements with all the strategic suppliers (i.e. those on which the <i>off-grid energy system</i> depends to continue the business properly) must be negotiated with appropriate performance guarantees and redress for failure to deliver or perform.	
12	<i>Appropriate contractual arrangements</i> especially with plant and equipment suppliers to ensure that maintenance and spare parts commitments are fully provisioned and honoured.	
13	<i>Appropriate standards for equipment</i> that are properly enforced. This to be achieved through adhering strictly to the type of equipment specified in the business plans during the venture development phase; and, relevant training of staff. This also to be a key task of the support project set up managers/consultant. If there are no local technical standards for equipment then either British or USA Technical	

	Standards to be adhered to. Such standards are available on the internet. These also to include proper guarantees and full compliance with International Safety Rules	
14	<i>Proper marketing, business and revenue acquisition plan.</i> Identify the market gaps, introduce products and services in a manner that customers will want them and establish the demand. Product and services must meet expressed needs of local consumers. All necessary provisions must be planned and made to market, sell, grow the local market, charge affordable tariffs, collect revenue and provide excellent customer service. Any customer financial or other incentives must also be specified and the costs included in the financial business plan	
15	A <i>detailed financial plan</i> plus adequate revenue measurement, supplier payment and audit systems must be established. Part of this plan must also embrace provisions for the repayment of any loans or funding used to establish the <i>off-grid energy system</i> . A budgetary system needs also to be created to assist with expenditure control and revenue management. Capital and ownership arrangements also need to be described	
16	<i>Provision for changes, particularly demand growth.</i> The demand for energy will grow and change over time so provision must be made to accommodate these changes. There may also be external factors impacting the <i>off-grid energy system</i> that must also be provided for. A most important possible external development may be the arrival of grid power and the best ways to integrate the <i>off-grid energy business</i> with this.	
17	<i>Business case.</i> The business case is the first major initiative necessary for the creation of an <i>off-grid energy system</i> . It must contain all the financial, technical, market, manpower, entrepreneur and management team critical information and <i>off-grid energy system</i> business model to enable an investor to assess the potential viability and commercial success of the venture. It is used to raise the necessary funding and capital to set up the <i>off-grid energy system</i> . Acceptable economics must be demonstrated to all stakeholders and customers.	
18	<i>Operational plan and blueprint.</i> The operational plan must contain as subsets a range of firm specifications including the marketing, revenue collection, customer service, staffing, technical, maintenance, staff training and development, performance management methods and the management team with all key roles and responsibilities specified. This plan must cater for necessary reinvestment, technical maintenance and provide a number of goals and targets to be achieved within stipulated timescales such as a year, five years and ten years	
19	<i>Favourable political, regulatory and political framework.</i> It is vital that relevant legislation and regulations that may apply to the <i>off-grid energy system</i> are fully understood and adhered to	
20	Adequate <i>management systems</i> must be specified and enacted. The need for progress reviews, performance against benchmarks, proper records and feedback mechanisms. Systems must be in place and carried out that enable swift responses to the day to day operational requirements of the <i>off-grid energy system</i> .	

In terms of supporting the development of *off-grid energy systems* in remote often poor communities it will be necessary to provide initial support both with some limited funding

and certainly with technical business support. It is suggested that appropriate Government agencies (e.g. Rural Electrification agency) or Donors have a modest local fund that can extend small loans to cover the costs of the pre-feasibility and the feasibility studies. From these the business case described above will emanate in readiness for formal submission to banks or funding agencies for full scale funding request for the establishment of the *off-grid energy system*.

1.7 Key personnel, activities and responsibilities

This section identifies the critical activities and responsibilities for designated personnel to enable the success of off-grid energy systems in terms of financial, technical, regulatory, safety and marketing sustainability. It also considers where best to start and how to make it all happen. Rather than a focus on roles or specific job designations it is important firstly to identify 'what needs to be done'; and, what are the essential activities to ensure success. Once these have been identified and described a range of further considerations can then be applied and appropriate organizational structures designed to suit particular *off-grid energy system* circumstances. Other considerations necessary to enable such 'fit for purpose' organizational design will include the scale of the *off-grid energy system*, number of customers, types of wholesale energy production plant, available skilled personnel, work volumes and complexities, opportunities for multi-tasking and the regulatory and health and safety operational factors involved.

Small off-grid energy systems with a limited array of customers and straightforward energy production and supply technologies may be suited to a small team of operational staff with multi-tasking where the work complexities and volumes permit. In large complex *off-grid energy systems* larger and more formal teams of operational staff will be necessary. The important matters to ensure however will be that all the essential activities are properly provided for, that the requisite level of skills and certification of personnel for certain duties and that costs are proportional to the revenue streams generated by the business. It will be essential to adopt a pragmatic approach to organizational design and manpower deployment ensuring that each *off-grid energy system* has a carefully tailored manpower organization suited to meet the commercial and market needs and local operating conditions. Rarely will there be a one size fits all solution to setting up the human operational organization for all the many different sizes and types *off-grid energy systems*. There will be however certain organizational and operational constants that will be essential and these are described below.

The critical activities for a sustainable *off-grid energy system* may be described and summarized as follows:

1.7.1 Leadership:

This includes a broad basket of activities that will start with ensuring a clear and understandable vision and mission for the *off-grid energy system*. Whether a general manager or a chief executive officer, the leader must also ensure the effective integration and coordination of all major *off-grid energy system* supply and demand side activities. This person will also be responsible for all interfacing with major stakeholders particularly funding agencies, the local community committee and representatives, consumer groups, regulatory bodies, Government officials and major suppliers. Repayment of loans, annual results reporting to key stakeholders and regular performance monitoring and reporting will all be this person's responsibility. Not necessarily producing all the detailed figures, but ensuring it gets done.

Proper governance of the business will also be the responsibility of this person. If the off-grid energy business is a limited liability company for example there may be various fiduciary responsibilities to shareholders such as an annual set of independently audited

accounts. The lodging of taxation returns and the timely payment of corporation and other taxes (such as VAT perhaps) must also be assured.

Leadership and motivation of the *off-grid energy system's* manpower team is a key activity. This together with performance monitoring and management will be critical success factors for the *off-grid energy system's* success or failure. Setting policy and targets and monitoring performance will enable the business to stay on course in meeting its vision. When unforeseen problems arise or failures occur it will be the responsibility of the leader to work with the *off-grid energy system* team to diagnose the reasons for failure and to put effective remedial measures in place.

Ultimately all the other staff in the business will report to the leader either directly or indirectly through another level of management. In general the flatter the organizational structure the better. Staff motivation and discipline where necessary will also fall under the remit of the leader. Staff development, enhancement of skills and experience of *off-grid energy system* personal are also the leader's responsibility. Proper succession planning must also be in place.

There is a final requirement that uniquely lies in the domain of the leadership basket of activities and responsibilities. It is to think not only short term and tactically about the achievement of defined outputs, goals and milestones but also longer term and strategically. It is to think and plan for the future, for the growth of the business and what may lay ahead 5 or 10 years into the future.

1.7.2 Technical

There are two key aspects to this broad range of activities and responsibilities. The first has to do with all the technical activities necessary to ensure the wholesale supply of energy, whether electricity, charcoal or other renewable energies such as solar or hydro power. These we can refer to as technical supply side activities. The second aspect is what may be referred to as demand side supply technicalities of everything necessary to get the energy to the customer.

For the larger installations it is recommended that the wholesale supply of energy is a separate business unit with its own entire dedicated operational manpower team. In this type of scenario there will be a production manager ensuring the regular supply of energy, the proper operation of production plant, receipt and testing of production equipment, consumable supplies receipt and payment, maintenance scheduling and completion; and, management of all technical suppliers, plant and services. The operation of a control room in the case of larger *off-grid energy system's* to manage the coordination of electricity production plant and the dispatch of electricity to supply networks will be required. In many cases those discharging supply side technical responsibilities will require appropriate regulatory/health and safety certification.

On the supply side, once the wholesale energy is available such as electricity it then needs to be distributed to consumers either via cable networks (electricity grids) or via batteries and recharging centres. In small *off-grid energy system's* a qualified electrician will be able to meet most of the distribution requirements. However in larger operations with mini grids, distribution electrical engineers may be required. Once constructed probably by electrical contracting companies, electricity supply networks must be managed and maintained. Routine work will be within the capabilities of *off-grid energy system* staff although larger and more complex work will require the support of technical subcontractors.

1.7.3 Financial

Financial activities in simple terms involve the prudent management of income and expenditure. On the income or revenue side of the equation it will involve operating an effective set of prices or tariffs for customers, various methods of payment, money

collection and banking and where appropriate metering. Such money collections have to be banked and a true and accurate record of all receipts maintained. On the expenditure front, it involves the proper authorization of payments to suppliers, third parties and the *off-grid energy system* staff payroll. Where VAT applies and any other taxation they must be paid and accounted for.

From income and expenditure activities regular accounts must be prepared, budgets set for all major expenditures and provisions made for plant renewal, maintenance and other activities. Quarterly and annually it will involve providing financial performance reports that show profits and that the *off-grid energy system* is adequately covering costs. Repayments of loans must also be provided for.

In small straightforward *off-grid energy systems* a book keeper may be able to discharge all the necessary financial activities. However if the operation is a large business with complex customer billing systems, large numbers of employees and so forth then a small dedicated financial team will be required under the leadership of an accountant.

For tariffs, it is customary that these are designed and then regularly reviewed against operating costs. In many utility situations tariffs are set by the finance department in consultation with the marketing function.

1.7.4 Marketing, Sales and Customer Service:

This bundle of activities and responsibilities involves everything necessary to do with the market that is served by the *off-grid energy system*, the different types of customer groups, their needs, metering electricity supply, the terms and conditions on which the *off-grid energy system* will supply customers, customer service arrangements, market research to enable the *off-grid energy system* to keep up with market trends and monitoring local competition. The design of the products and services and advertising them to potential customers will also be the work of marketing. The sales function will handle promotion of the products and services directly to potential customers, signing on new customers and arranging for the necessary technical connections with the technical department. Customer service must ensure high levels of customer satisfaction and a perception by all customers that they are receiving good value for money. In general this also involves handling customer queries or complaints quickly and sympathetically. It must also ensure that customers know how to use the *off-grid energy system* products and services properly to gain maximum benefit and safely at all times.

A crucial marketing and sales activity is ensuring a comprehensive knowledge of the local market and customer base. Proper customer records are essential together with continual reviews of the state of the local energy market. This activity includes being the 'eyes and ears' of the business monitoring competition and all local market place developments likely to impact the business.

1.7.5 Other necessary supporting activities:

In large integrated energy utility operations there are a range of other necessary activities that are all contained under one roof. However, for many smaller *off-grid energy systems* they should not have to provide for such functions internally but rather buy them in as necessary. Described below are a range of specialist services that *off-grid energy systems* will need to avail themselves of from outsourced service providers:

Regulatory

It will be essential that all *off-grid energy systems* are fully conversant with all the relevant regulatory rules and conditions that apply to them and that they strictly adhere to them. External consultants can provide such guidance and undertake an annual audit for a fee as necessary to ensure on-going adherence.

Health and Safety

The supply of energy is a complex and technical matter often involved with potentially dangerous products, materials and activities. Many technical rules and regulations will apply and it will be essential to comply with all relevant health and safety rules, regulations and local legislation. External specialists are available to regularly advise on such matters and to conduct periodic operational reviews to ensure continuing compliance.

Audit/independent financial accreditation and checks

It is likely that for taxation and other financial governance and regulatory requirements that an audited set of *off-grid energy system* accounts will be required at least annually. External audit firms are available for a fee to meet these needs. Those funding bodies who have loaned capital to establish the business and other owners of shares of the business will certainly require audited annual accounts.

Procurement

For the procurement of major items involving capital expenditure external specialists are available to handle matters such as product specifications, invitations to tender, tender adjudication and contractual supply arrangements. Such specialists will also handle project management as necessary together with installation and plant commissioning.

Legal

From time to time an *off-grid energy system* may require legal services. Whether it is to advise on a dispute with a large customer or to settle a claim against a supplier, whatever the particular circumstances, the business need access to external professional legal services.

Human resources and staff training

The recruitment, interviewing, assessment and selection of staff can also be supported by external specialists. Training may also be provided that is tailored to the precise needs of the *off-grid energy system* by external service providers.

1.7.6 Making it all happen and resourcing a potential *off-grid energy system*

The way in which the above activities have been classified and described, is one way among many. However what is important is that every activity described is provided for in the final *off-grid energy system* human operational organization. The activities described above must become the responsibility of defined roles or job positions operating within the *off-grid energy system*.

In the *off-grid energy system* guidebook specific quantitative guidelines are provided related to matters such as *off-grid energy system* size, scope and customer numbers, technical complexities, probably work flows and volumes, and ownership arrangements and other necessary information to assist with the design of specific operational organizations to suit and satisfy the needs of different sizes and types of *off-grid energy system*. These additional levels of detail and quantification will thereby enable the essential activities and responsibilities itemized above, to be met.

It is important to reflect however at this stage on two foundational questions and the answers, namely:

How does a *off-grid energy system* get established?

An *off-grid energy system* must be based on a substantive business case that in turn must be fully supported by an adequate level of market demand within a defined geographical area to be served. Some modest seed financing will be required to cover the cost of a thorough local market assessment. Where ever possible potential demand for energy and the *off-grid energy system* services from local productive enterprise must be viewed as the cornerstones of such energy supply enterprise. The business case will enable money to be raised either as development aid funding or commercial funding (and it is strongly

recommended that there be a balance of both) to enable the set-up of the *off-grid energy system* business operation. From this point on everything that will be required is described in generic terms in this document and in detail in the Guidebook..

Where does one start?

Yet, where does one start and what critical enabling skills will be required. *Off-grid energy systems* ultimately must be owned and operated by local people. However in most cases local people suited to operate such a business must be identified and then coached/mentored with appropriate skills transfer. To get started an enabling project manager must visit communities where there is potential for the establishment of sustainable *off-grid energy systems*. Local entrepreneurial and leadership talent must be identified. Having achieved this such individual/s need to be recruited, provided with initial training and then set the task of undertaking, under supervision and guidance, a thorough local market evaluation. This evaluation will provide the first major 'building block' on which the whole *off-grid energy system* will be built. The local person/leader/entrepreneur must also be the singularly vital enabler around whom the *off-grid energy system* is created, mentored into being a long term successful local energy business and owned along with other key stakeholders such as funders and the local community.

The current model of CPCs and other donor funded energy systems to a local community energy committee has been found not to work satisfactorily. There has to be a singular person on the ground who must assume the necessary leadership and ultimately the ownership (in part with other stakeholders or even in time complete ownership) of the business. When people have a major personal stake in any activity they are sure to make a success of it and ensure all that is vital to the survival and growth of the business, gets done.