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Non-Financial Returns of Enterprise-Led Development Assistance

A study of energy-related enterprises

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Chaim Kolominskas, Lund, September, 2003.

Abstract

The Rural Energy Enterprise Development (REED) initiative provides assistance to energy-related enterprises to prepare them for growth and to make eventual investments by mainstream financial partners less risky.

This study assesses the non-financial returns of a number of REED-type enterprises and provides guidance for the selection and ongoing evaluation of these enterprises within the context of development interventions.

This study concludes that desired development outcomes should provide the basis for programme objectives against which non-financial returns can be measured. However, qualitative information is also necessary, as the context within which an enterprise operates largely defines the importance of these returns. Further work to improve the understanding of this context is necessary prior to the development of a formalised monitoring programme. Limitations of the assessment process should be recorded and addressed through the ongoing review of the programme, other monitoring efforts and further research.

Executive Summary

Within a Rural Energy Enterprise Development (REED)-type development intervention, aspects directly affecting the ongoing financial viability of the enterprise are relatively closely monitored. However, the non-financial returns of these interventions, which often reflect significant progress towards sustainable development, and add value to both the enterprises and society, are often not recognised.

This thesis has the objective of improving the understanding of the contribution of the non-financial returns of energy-service enterprises towards sustainable development. As part of this objective, this study also aims to further facilitate the incorporation of non-financial aspects into sustainable development-related decision-making processes.

An overview of development and sustainable development shows that the two concepts are in many aspects overlapping, perhaps even converging, and both require a multidisciplinary understanding of, among other things, wellbeing, freedom, natural resource use and poverty. A review of these concepts provided a pool of issues that could be used as a resource in identifying relevant targets and impacts.

In practice, the incorporation of non-financial aspects into the ongoing decision-making processes of enterprises can be simplified into a general process of setting objectives and targets, monitoring the progress towards these objectives and targets with quantitative and or qualitative indicators, and regular review of the process.

Such a process was therefore used in this study to determine the non-financial returns from 14 enterprises supported using the REED model of development. The enterprises were located in six different countries: Zambia, Tanzania, Mali, Ghana, Senegal and Honduras. Enterprises involving charcoal briquette manufacture, improved charcoal stove manufacture, solar baking, motor control equipment retail, biomass energy production, jatropha platform operation, solar food drying, power factor correction equipment retail, LPG retail, compact fluorescent equipment retail, solar hot water heater maintenance, wind powered water pump maintenance and hydro power production were studied.

Financial support ranged from a USD 15 170 loan to a USD 250 000 loan. One enterprise was supported through an equity investment rather than a loan.

Avoided deforestation (or reforestation), job creation, waste utilisation, avoided environmental impacts of traditional charcoal production, avoided health/environmental impacts of traditional fuel use, labour/time savings, increased personal/household income, electricity savings, cost savings, fossil fuel substitution, empowerment of women, electricity supply, health benefits of reliable water supply and infrastructure improvement were documented as the types of non-financial returns of these enterprises.

However, after an estimation of the non-financial returns of the enterprises, it became apparent that the following issues are likely to be important when developing a monitoring programme for non-financial returns:

- Both qualitative and quantitative information is necessary as an appropriate basis for decision-making, as the context (e.g., community needs and behaviour) within which an enterprise operates largely defines the importance of particular non-financial returns.

- Some further work is required in developing appropriate categories of impacts within a monitoring programme. Desired development outcomes of the programme should

provide the basis for categorisation and should set the objectives by which an enterprise can be measured. This may imply further work in gaining this understanding of the communities affected by REED-type interventions.

- The choice of indicators for the measurement of non-financial returns is strongly limited by data availability. In fact, indicators cannot always be selected. Limitations should be accepted and recorded so that they can be addressed during the review process. Some basis for decision-making is better than no basis at all.

- The monitoring of non-financial returns should be an ongoing and flexible process. This study provides a useful starting point for the development of an ongoing monitoring programme. Relevance, redundancy and transparency should be important aspects in the development of indicator selection criteria for each individual programme.

- Some aspects may be better considered under internal company management procedures, existing regulatory frameworks or the monitoring of broader policy objectives. Monitoring within an enterprise-based programme cannot be holistic, and clear boundaries must be set to define which non-financial impacts can be assessed. Further work should involve developing useful local capacity in the management of non-financial aspects within private enterprises.

Taking into account the results of applying this simplified assessment methodology to a number of cases, guidance for the further assessment of enterprises was developed. This guidance is based on a simplified process developed as a result of a literature review and applies to most processes attempting to incorporate the ongoing assessment of non-financial aspects. The process can provide the basis for a more formal monitoring procedure and perhaps the integration of non-financial aspects into financial decision-making. This study provides a useful starting point for such a process. A further review of data collection methods is likely to be instructive.

The identification, description and quantification of non-financial returns provides a basis for the incorporation of non-financial benefits to society into the value of the enterprise itself. However, the selection and ongoing monitoring of these returns requires some development through ongoing review of the programme, other monitoring efforts and further research.

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1. Introduction

1.1 Background

Energy services and the way they are delivered have significant influence on progress towards sustainable development. These services were traditionally delivered by governments through centralised policy, but in recent decades the role of the private sector has been considered as a more effective delivery tool (Johansson & Goldemberg, 2002).

However, the often significant development-related benefits to communities associated with small-scale rural enterprises delivering energy services are, in many cases not, or only partially, incorporated into investment decision-making processes and there is a need to further recognise these non-financial benefits, so that they can be appropriately incorporated into policy making processes.

1.1.1 Energy and Sustainable Development

Whichever definition of sustainable development is used and however this definition is transformed from a broad concept to something more operational (both issues are discussed further in Section 2.2), it is largely agreed that progress towards sustainable development is closely linked with how energy is used and produced.

The energy use patterns of society has influence on many aspects considered important for sustainable development such as levels of poverty, income, women's social development, population growth, food security and general self-reliance. In fact, *Our Common Future* (WCED, 1987), which formed the basis of the original definition of sustainable development, described the challenge of sustainable development as an interrelated problem of environment, development, energy and security (Kirkby, O'Keefe, & Timberlake, 1995). Furthermore, an increase in per capita energy services is correlated with an increase income and life expectancy and a decrease in infant mortality, illiteracy and fertility rates (UNDP, 2000), which are considered as aspects of human welfare, and perhaps sustainable development. Moreover, it is found that at low levels of energy consumption (e.g., in developing countries), much improvement in quality of life can be made with small improvements in energy services (Johansson & Goldemberg, 2002).

The use of energy is also associated with various impacts on the environment. Often significant environmental impacts occur during all stages of the fuel chain (i.e., harvesting/extraction of fuel, processing, distribution and use) and consist of indoor, local, regional and global impacts on human health and ecosystems (Johansson & Goldemberg, 2002).

Significant changes in the current energy system are needed to achieve sustainable development and in many places, delivering energy services in way that leads towards sustainable development requires significant changes to policies, markets and technologies (Johansson & Goldemberg, 2002; UNDP, 2000). Therefore, it is clear that progress towards sustainable development is likely to be significantly influenced by the level of access to modern forms of energy and the methods of its generation and use.

1.1.2 Energy Services and Energy Enterprises

An energy system consists of an energy supply sector and end-use technologies. The objective of this system is to deliver to consumers the benefits that the use of energy offers.

The concept of *energy services* is used to describe these benefits (UNDP, 2000). *Energy enterprises* are therefore defined in this report as enterprises that deliver these services.

Some examples of energy services are heating, lighting, space conditioning, food storage, provision of clean water and sanitation, transportation, motive power, heat, commerce and communication (UNDP, 2000).

In providing these services to those who need them, the focus of energy related development assistance has shifted from one of simply providing technology, demonstrations and gifts of financial aid to that of empowerment, markets and investments. Also, the focus of governments is shifting from centrally planned approaches to more market oriented activities, and to the creation of competitive environments conducive to private sector investments in clean energy (UNEP & UNF, 2003).

Recent evidence supports the argument that energy productivity will improve as economies shift from central planning to a greater role for markets. An important consideration in developing countries is that more liberal energy markets are associated with greater access to commercial fuels – electricity, diesel, and liquefied petroleum gas (LPG) – for the poorer members of society, and that this can have significant social and economic development benefits (Johansson & Goldemberg, 2002). There is now a general recognition that the private sector can be a major driving force towards building a local human capacity to produce and distribute modern energy services (UNEP & UNF, 2003).

In summary, although the reasons and the specific solutions may differ, governments in industrialised, transition, and developing countries acknowledge the potential benefits of bringing a greater role for market competition to the energy sector. However, it is also recognised that this transition should include an effective mix of policies and investment that ensure social development that would otherwise be ignored by the market (Johansson & Goldemberg, 2002).

However, at present, low private sector involvement is still seen as a barrier (OECD, 2001b) and improving local capacity to commercialise sustainable energy sources is critical to stimulating sustainable markets (Kozloff, 1995). Finance and infrastructure is needed to create the systems and networks to deliver the financial support, institutional support and capacity building to support and facilitate the creation of sustainable energy markets (ITDG & Greenpeace, 2003). Rural areas are seen as particularly important and energy policies that identify and enhance market opportunities in rural areas are essential for economic and social development, and can be an important engine for growth in many developing countries (UNDP, 2001a). Policies which promote technological innovation are seen as complementary to these policies and venture capital provision is an important aspect of fostering this innovation (Johansson & Goldemberg, 2002).

1.1.3 Financial and Non-Financial Returns

A non-financial return is, for the purposes of this study, defined as a measure of the impacts of an enterprise that, in some way, indicates progress towards sustainable development. A measure may be qualitative or quantitative. This definition may include impacts that can affect the value of the enterprise or its products/services, such as image related to environmental or social performance, but an established link between non-financial returns and enterprise financial value is not a prerequisite for assessment in this study. Some non-financial returns of an enterprise may only be of benefit to society, and not the enterprise

itself, and are therefore still considered important when assessing progress towards societal sustainable development objectives.

Non-financial returns may be considered important for a number of reasons. In general, society often needs to be better informed regarding the extent of environmental and social challenges, to be able to make appropriate decisions regarding their management. Considering enterprises specifically, poor performance in non-financial aspects have been associated with financial risks and the management of non-financial aspects is considered by many to be important in meeting long-term financial objectives. Further, the good management of non-financial aspects has also been shown to lead to better quality goods and services (Bennett & James, 1999).

However, international development stakeholders and investors often choose not to invest in small-scale energy related enterprises with potentially significant social or environmental (i.e., non-financial) returns because (UNEP & UNF, 2003):

- The enterprises are too small (i.e., transaction costs are too high) for the financial support to be cost-effective;

- The enterprises operate in remote rural areas where the communities are too poor to sustain the business;

- The enterprises maintain no formal book-keeping; or

- Development agencies and governments often believe that centralised programs are preferable for delivering the socially beneficial services that the enterprises could otherwise provide.

In other words, many investment decisions are being made based only on financial aspects, or those non-financial aspects that can be incorporated into standard financial decision-making processes.

Therefore, there is a need to demonstrate the potential non-financial benefits of small-scale energy related enterprises so that these benefits can be either better incorporated into financial decision-making processes or acknowledged in some other way. The general problem is illustrated in Figure 1-1. Non-financial benefits from enterprise-related development projects can be reflected as either value to the enterprises themselves or as value to society. A challenge is to incorporate these benefits to society, through policy, into market characteristics so that they can be translated into benefits to the enterprise. Once the benefits to society are reflected in the value of the enterprise, investments in these types of enterprises should be more attractive and more investments should occur.

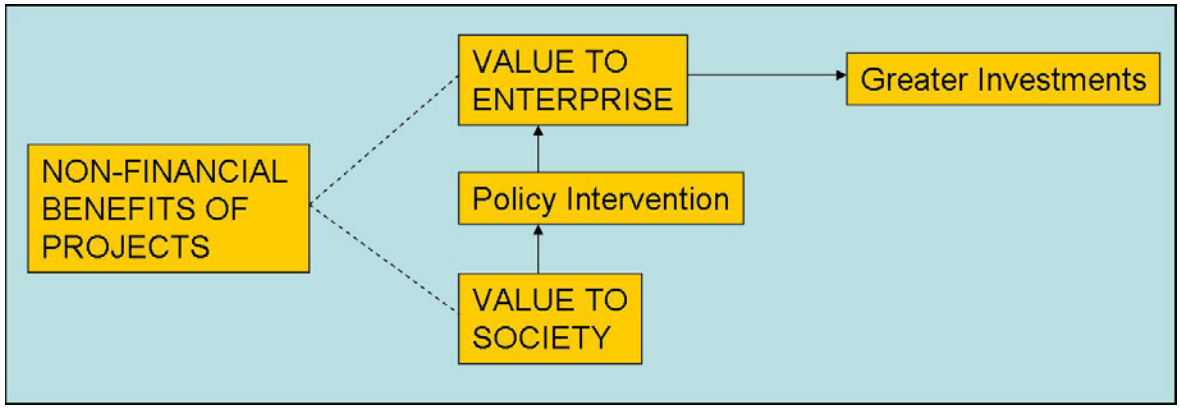

Figure 1-1: Incorporation of Non-Financial Benefits into Enterprise Value

In general, formal and informal institutions in recipient countries must assume a greater, long-term monitoring and evaluation role. This implies the need for skills development, adequate resources and an institutional environment in which on-going monitoring is perceived as a useful input to policy review and resource allocation processes (DFID, 2003).

1.1.4 Enterprise Led Development Assistance and the Rural Energy Enterprise Development (REED) Projects

Within the context outlined above, and as one measure promoting energy use that leads towards sustainable development, a partnership between the United Nations Foundation (UNF), the United Nations Environment Programme (UNEP), a not-for-profit investment company E+Co and a number of local non-governmental organisations (NGOs) has created the Rural Energy Enterprise Development (REED) initiative.

This approach (referred to hereafter as "The REED Approach")[1] offers rural energy entrepreneurs in Africa, Brazil and China a combination of "enterprise development services" and financial support. Enterprise development services are primarily training and educational tools to help entrepreneurs start and develop energy businesses and management support in areas such as business planning (e.g., how to write a business plan), structuring a company, financing and facilitation of contact with potentially important stakeholders such as banks and local NGOs (UNEP & UNF, 2003).

This model of development assistance can be considered as *enterprise-led development assistance*, whose objective is to allow entrepreneurs to plan and structure their companies in a manner that prepares them for growth, and makes eventual investments by mainstream financial partners less risky (UNEP & UNF, 2003).

The REED approach is illustrated in Figure 1-2, which shows the various stages of enterprise development and the type of support that is given at stage of the process. Figure 1-2 shows that, initially, an entrepreneur with a business idea submits a business proposal. This proposal is then developed into an official business plan with the support of enterprise development services (as described above). This business plan is then submitted to the project administrators who decide whether the plan should be supported. Financial and management support is then given to the entrepreneur to implement the business plan and further support is provided after the implementation phase if required.

[1] Note that the term "REED approach" applies to all interventions using the same model of support (e.g., support of enterprises by E+Co previous to the REED initiative).

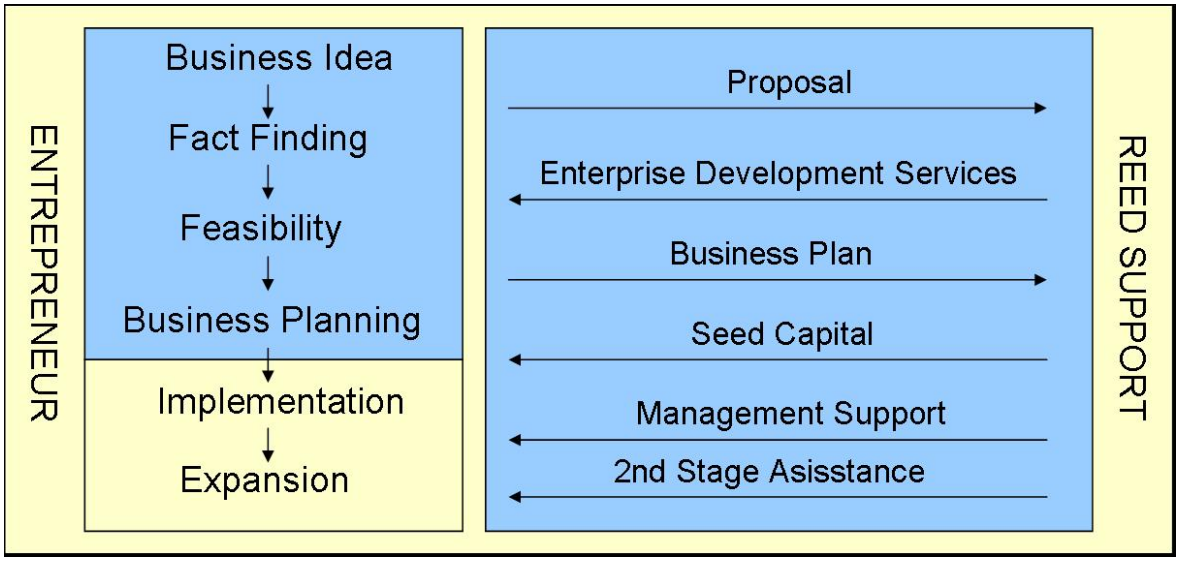

Figure 1-2: The REED Approach of Development Assistance (adapted from UNEP & UNF (2003))

As opposed to aspects relating to financial viability, the non-financial aspects or progress towards sustainable development of the supported enterprises within REED-type projects are not consistently monitored and very little public documentation of the non-financial impacts of these types of enterprises exists. The focus tends to be on the development project or programme as a whole. Currently, in the REED initiative, non-financial aspects are assessed through the comparison with a set of investment guidelines. These guidelines are in the form of questions relating to particular non-financial aspects and are listed in Table 1-1. At this stage, no guidance or methodology exists on how these questions should be answered.

Table 1-1: REED Non-Financial Investment Guidelines (E+Co, 2003)

Aspect	Guidelines
Social and Environmental Elements	Does the enterprise improve the quality of life through the provision of energy services or use of energy for income-generating purposes? For example, will it target underserved communities to create employment opportunities? Will the project improve or protect the local, national, and global environment? Will it displace harmful energy sources such as diesel, kerosene, candles or firewood? Will the use of clean energy increase income to the community?
Technology	Does the energy enterprise utilise an *appropriate technology* when compared on the basis of cost, affordability and environmental impact?
Policy Framework	Does the enterprise/project influence policy makers and decision makers to support renewable energy and energy efficiency initiatives?
Human Capability	Does the enterprise/project improve national or local capacity to promote renewable energy and energy efficiency initiatives?
Public Interest	Is the intervention by REED necessary to advance the enterprise? Will the project/energy enterprise utilize clean energy technologies in a commercial fashion and attract new sources of investment? Will it demonstrate an innovative approach to clean energy production and use? Will it provide improved clean energy services to underserved or unelectrified rural or peri-urban communities?

In summary, little comparable evidence exists regarding the non-financial benefits of REED-type development interventions and more guidance is needed regarding the ongoing monitoring of non-financial returns of these types of enterprises.

1.2 Research Objective

There is a general need to demonstrate the potential non-financial benefits of small-scale energy related enterprises so that the assessment of these benefits can be either better incorporated investment or other decision-making processes.

This thesis therefore has the general objective of improving the understanding of the contribution of the non-financial returns of energy-service enterprises towards sustainable development. As part of this objective, this study also aims to further facilitate the incorporation of non-financial aspects into sustainable development-related decision-making processes.

1.3 Research Questions

This study aimed to answer the following research question:

> *How can the assessment of non-financial returns be incorporated into the development support of REED-type enterprises?*

This research question is considered to comprise of the three following questions:

- How could the non-financial aspects of REED-type enterprises be monitored?
- What are the non-financial returns of enterprises that have been supported using the REED-approach of development?
- What are the important issues for consideration when designing an ongoing programme for the monitoring of non-financial returns from these enterprises?

1.3.1 Scope of the Study

Although this report is an academic submission related to the field of development assistance, its readership is also intended to comprise of those who are engaged in the design or implementation of REED-type, or similar, development assistance work. Section 1.4.1 shows how this thesis is organised for different readers.

A REED-type enterprise is one that has received development assistance in the form specified in Section 1.1.4 of this report. Also, the distinction is made here between an enterprise, which is the subject of the development assistance in the REED programme, and the programme (or project) itself.

As the primary research question of this study is aimed at assessing the non-financial returns of specific enterprises, or specific types of enterprises, the monitoring of development projects or programmes is not explicitly addressed. Some guidance relevant to the monitoring of development programmes may be obtained from this study, but it is not the focus of the work.

Although financial viability may be associated with sustainable development, this study does not attempt to address any questions regarding the financial viability of the enterprise, and this is implicitly assumed in all analysis. Furthermore, although an assessment of non-financial aspects could lead to the development of monetary measures for non-financial aspects, through government interventions to give activities that are socially desirable a

value/role in the market-place, and the subsequent incorporation of non-financial aspects into traditional financial decision-making processes, this is not addressed in this study.

Also, although the assessment of non-financial returns of enterprise is often considered within the broader context of the management of an enterprise, the internal management processes of the enterprises are not assessed as part of this study.

This study does not attempt to provide specific government policy-related guidance regarding the incorporation of non-financial aspects into financial decision-making processes, although information that could form the basis of such guidance is provided.

1.4 Methodology

The research problem posed in this study is considered to require the understanding of two broad issues:

- An understanding of the non-financial impacts that enterprises can have; and
- An understanding of how these impacts can be monitored and managed.

Considering that the REED projects operate within a context of development interventions, an understanding of development theory is considered important and was the subject of a literature review (Section 2.1). Non-financial returns are also intended to provide an indication of progress towards sustainable development, and therefore, an understanding of the concept of sustainable development is also considered important (Section 2.2).

Subsequently, once an understanding of non-financial impacts is achieved, the monitoring and management of these impacts should also be reviewed (see Section 2.3). Good knowledge of the management of non-financial impacts, together with an understanding of the concept of non-financial impacts can then guide the development of an assessment methodology that can be used to assess returns (Section 2.4).

The issues that arise from the testing of this methodology can then form the basis for the development of an ongoing monitoring programme.

Case analysis is typically recommended when a phenomenon is not readily distinguishable from its context (Yin, 1993). The importance of non-financial impacts of enterprises is often highly context specific. For example, a particular environmental impact such as deforestation may be of high importance for one community where they rely on it for cooking fuel and of less importance in another community where liquefied petroleum gas (LGP) is used for cooking. Therefore, the documentation of non-financial impacts is best provided together with its context, as was done here. The importance of context may make it difficult to draw general conclusions from such an analysis. However, using multiple case studies can help to overcome this deficiency (Bryman, 1989).

The 14 cases used in this study were selected based on whether they were consistent with the REED model of development and whether sufficient contextual information was likely to be available to develop a set of cases that met the research objectives. Of the UNEP supported programmes, AREED (African REED) is the oldest, could provide most information, and provided 13 cases. BREED (Brazil REED) and CREED (China REED) have not yet supported any specific enterprises and could therefore not provide any existing cases. One

further enterprise, originally supported by the organisation E+Co, was selected as it was older and larger (in terms of financing) and could potentially provide more information than the other enterprises. About 70 enterprises have thus far used the REED approach of development assistance, although many are not at a sufficient stage of support to allow for proper assessment. A variety of businesses were studied with the only business type occurring more than once being charcoal stove manufacturing (see Section 3.1 for further information). The 14 enterprises selected were therefore considered to provide a good representation of the types of enterprises currently using the REED approach.

Either the local programme partners of the REED programme or the entrepreneurs themselves were requested (through semi-structured telephone interviews or email requests) to identify the non-financial impacts caused by specific enterprises. Interviewees were also requested to provide any information that could help to quantify these impacts. A semi-structured approach was used because flexibility was needed to be able to obtain the information needed for a reasonable number of cases. For example, some respondents preferred ongoing email correspondence, while others were available for only one or two telephone interviews. Based on literature examples of similar enterprises, examples of non-financial impacts were provided to facilitate discussion.

This approach has two significant limitations. Firstly, it considers only those non-financial returns for which the contributions from particular enterprises can be assessed. In some cases, impacts may be better assessed using approaches that consider only the communities or the countries in question. It is however intended that where the approach used in this study is not suitable for a particular type of non-financial return, this should be recorded to allow for further study.

Secondly, this approach does not allow an in-depth analysis of the context for each case. The use of a relatively large number of cases provides general findings that can be used in different contexts by practitioners engaged in development assistance work. A more detailed analysis of context and, therefore, the study of fewer enterprises, would compromise this outcome. However, the cases do provide a summary of the non-financial returns associated with each enterprise, and the potential importance of these impacts, and can be used as a basis for more detailed research that can feed into the general findings of this study (i.e., strengthening the cross-case analysis and subsequent general findings).

Further, although a review of appropriate data collection methods may be instructive, such a review is beyond the scope of this study and is not performed here.

1.4.1 Reader Guidance and Organisation of the Study

Figure 1-3 outlines the organisation of this study and may provide guidance towards sections of interest for specific types of readers. Considering the close links between energy use and sustainable development, the subsequent establishment of the REED model of development and the general research objectives (all found in Section 1), a number of research questions were developed (Section 1.3).

To address these questions, a literature review was performed on three issues that were considered relevant to this study:

- Development theory (Section 2.1);
- Principles of sustainable development (Section 2.2); and

- The monitoring and management of non-financial impacts within enterprises (Section 2.3).

The literature review was intended to guide the development of an assessment methodology that could be applied to a number of existing enterprises (Section 2.4).

This assessment methodology was subsequently applied to a number of existing enterprises (Section 3) and taking into account a discussion of the important issues to arise from the assessment and the limitations of the study (Section 4), guidance for practitioners was provided regarding the selection and ongoing assessment of enterprises based on non-financial returns (Section 5). The conclusions of this study are presented in Section 6.

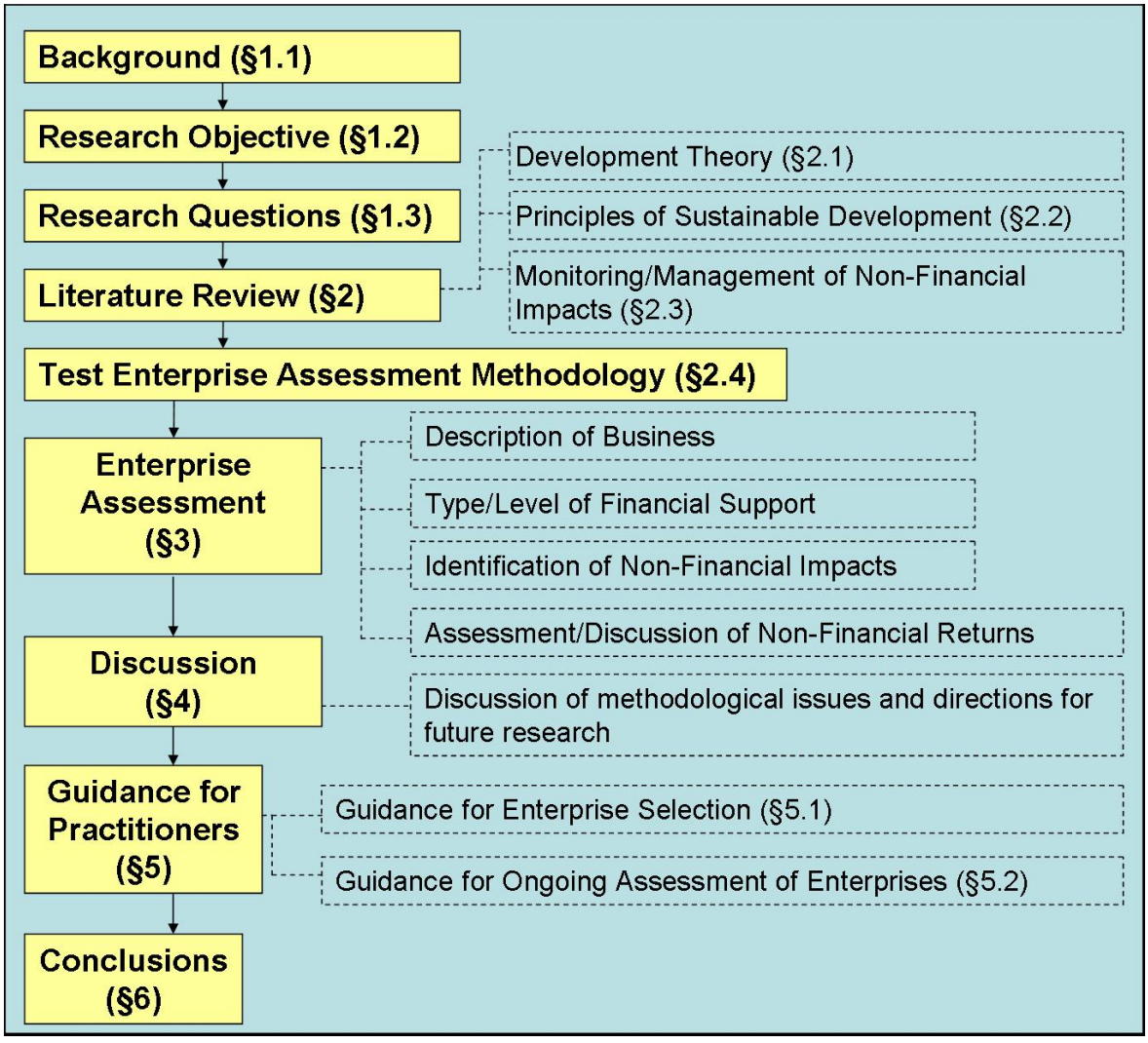

Figure 1-3: Organisation of the Study

2. Literature Review

Considering that the REED projects operate within a context of development interventions, an understanding of development theory is considered important and is reviewed in Section 2.1. Further, non-financial returns are intended to provide an indication of progress towards sustainable development, and therefore, an understanding of the concept of sustainable development is also considered important. The concept of sustainable development is reviewed in Section 2.2.

Subsequently, once an understanding of non-financial impacts is achieved, the monitoring and management of these impacts should also be reviewed (see Section 2.3). Good knowledge of the management of non-financial impacts, together with an understanding of the concept of non-financial impacts can then guide the development of an assessment methodology that can be used to assess the non-financial returns of REED-type enterprises. Section 2.4 outlines the assessment methodology that was tested in this study.

2.1 Development Theory

This short review of development theory highlights some important interpretations in the concept of development and the general trends in this understanding.

2.1.1 Economic Development

Initially, with political origins, development theory was an economic discipline. Over time, the concept has become multidisciplinary and now includes the study of the concepts of welfare, freedom, livelihoods, poverty and sustainable development, all of which are themselves multidisciplinary.

Modern development cooperation is considered to have begun as a policy tool for the spread of democracy through the transfer of science and industrial progress (Hoebink, 1997). Later, this political ideology was given a theoretical basis in economic theory. This theory considers how an economy uses available resources (e.g., natural resources, population, technology) to produce goods and services. Development is then assessed by how economic growth is constrained by limits or imbalances in these resources and how these limits or imbalances (e.g., market distortions) can be rectified (Halsnaes, Verhagen, La Rovere, Klein, & Huq, 2003).

However, it should be noted that economic growth is not always considered a pre-requisite for development and has, for example, been considered as merely a symptom of the necessary innovation resulting from the approach of ecological limits (Wilkinson, 1973).

This theoretical basis of economics has subsequently been developed into trying to gain an understanding of why economies in practice are not allocating resources optimally and how more efficient resource allocation can be achieved. For example, factors such as cultural demographics (e.g., fertility rates) and factors affecting economic growth (scale of production, economic efficiency, technological innovation, investment, institutional structure) have all been considered important in this field of development theory (Crafts, 2001). A further example is the *structuralist* theory, which emphasises that the objective of development is the structural transformation (e.g., increase levels of technology, import substitution, establishment of domestic demand) of underdeveloped countries in such a way as to permit a process of self-sustained economic growth (Halsnaes et al., 2003).

However, by focussing on industrialisation only, it has been found that in many developing countries, the rural sector is left neglected and a "dual economy" develops. This dual economy consists of a capitalist sector which saves or invests the significant fraction of its profits, resulting in persistent technological progress, and a non-capitalist, or pre-capitalist sector, which is more a less a subsistence economy with production mostly being used for immediate consumption and with negligible investment (Skarstein, 1997). This dualist theory of development attempted to account for this deficiency by emphasising the need for specific support to the rural sector in terms of technology, goods and resources required by rural people (Halsnaes et al., 2003).

Whereas traditionally, the market is seen as the allocation mechanism, other work has focussed on the importance of institutions in the allocation of resources (Peet & Hartwick, 1999). Institutions in this sense are the aspects of society that deliver the allocation of resources (e.g., financial sector, information technology) and the strength of institutions explains the differences between theoretical and practical resource allocation (Meier, 2001).

2.1.2 Sociological Development – Modernisation

Another group of theories derive from the discipline of sociology and are concerned with the modernisation of society from traditional, underderveloped societies to modern, developed and societies with a certain set of sociological characteristics (Peet & Hartwick, 1999).

The theory of *structural functionalism* sees modernisation of a problem in integrating nature, culture, society and rationality and contends that modern societies are complex as a result of a high level of subdivided social functions (i.e., differentiation), that are well integrated and are adaptive to change (Peet & Hartwick, 1999). The theory of *sociological modernisation* also considers differentiation an important aspect of modernity, but together with the development of free resources that are not predominantly owned by any set group, identities in terms of national or super-national boundaries and specialised institutional roles and mechanisms that are exemplified by markets, party politics and diverse bureaucratic organisations (Eisenstadt (1973) in Peet & Harwick (1999)). This theory has been further developed to define modernisation as an increase of capacity in the following aspects (Peet & Hartwick, 1999):

- Economically – e.g., the specialisation of economic activities and occupational roles together with the growth of markets;
- Sociospatially – e.g., urbanisation, mobility, flexibility, spread of education;
- Politically – e.g., the spread of democracy and the weakening of traditional elites; and
- Culturally – e.g., a differentiation in value systems (e.g., separation of religion and philosophy, secularism and an emergence of new intellectual groups.

The field of *economic modernisation* typifies a modern society as one that includes a complex division of social labour, a relatively open social structure with absence of caste barriers and surmountable class barriers. In such a society, economic gains are distributed based on achievement alone and individuals have freedom to pursue economic self-interest. Cities are seen as centres of innovation and a shift in power to urban modernisers is encouraged (Peet & Hartwick, 1999).

Finally, *psychocultural* theories of modernisation focus on psychological (e.g., optimism, empathy, open to knew experiences), cultural (e.g., not fearful of religious or cultural traditions that inhibit creativity) and behavioural (e.g., high value on technical skills) aspects of modern societies and how to achieve them (Peet & Hartwick, 1999).

However, the main criticism of these theories of modernisation is that they see development as a pursuit of western ideals in terms of institutions, markets, rationalisation and culture (Peet & Hartwick, 1999). However, theories of development based on human welfare (Section 2.1.3) at least partially address these criticisms.

2.1.3 Human Welfare

While these largely economic theories of development were evolving, another group of development theories focussed on the aspect of human welfare (Halsnaes et al., 2003). Dasgupta (1995) for example, recommends to study the access to resources, as opposed to outcomes. Freedom of access to income and basic needs (e.g., education, food, energy, medical care) is considered as the fundamental basis for human well-being (Dasgupta, 1995). More specifically, Sen (1999), sees development in terms of the freedom of individuals. In economic terms, this area of research focuses on how capital is allocated rather than how much is accumulated (Meier, 2001). Peet & Harwick (1999) also suggest a model of development where human contentedness and happiness are the objectives of material productivity.

The development of *human capital* has also been an important aspect of development work. Human capital is measured by knowledge, health, nutrition, skills and improvements in these aspects is believed to lead to increased productivity (Meier, 2001).

Relatively recently, multilateral development agencies have seen development in terms of poverty alleviation, with the definition of poverty progressing from a focus on the bare necessities of life, to the means to purchase them to the social and political circumstances that guarantee their provision (Halsnaes et al., 2003). It is now generally agreed that poverty is a multidimensional concept that incorporates material deprivation, low levels of education and health and vulnerability and exposure to risk (WB, 2000b).

2.1.4 Sustainable Development and Development – The Sustainable Livelihoods Framework

As an attempt to integrate many of the aspects of development together with the concept of sustainable development, a number of organisations that engage in development work[2] have adopted, at least in part, the sustainable livelihoods framework.

The essence of this framework is to develop an understanding of the ways in which people make their livelihoods and the factors that influence these livelihoods. The idea is then, through development assistance, to remove restrictions, or to provide as much freedom as possible for people to make their livelihoods in the way that they feel is most appropriate.

[2] For example, The World Bank, The World Business Council for Sustainable Development, International Institute for Environment and Development, The International Institute for Sustainable Development, United Nations Development Programme, Department for International Development (UK), Oxfam.

Sustainable development in this context has a number of characteristics. Livelihoods are considered sustainable when they (DFID, 2003):

- Are resilient in the face of external shocks and stresses;
- Are not dependent upon external support (or if they are, this support itself should be economically and institutionally sustainable);
- Maintain the long-term productivity of natural resources; and
- Do not undermine the livelihoods of, or compromise the livelihood options open to, others.

In this framework, a livelihood comprises the capabilities, assets (including both material and social resources), activities and choices required for a means of living (DFID, 2003). A livelihood may include a diverse range of actions and choices such as productive activities, investment strategies and reproductive choices.

2.1.5 Concluding Remarks

A review of development theory shows that the concept is multidisciplinary and a single measure is unlikely to be adequate. Most development theory looks at society as a whole and the assessment of contributions of specific enterprises is not specifically addressed. However, the aspects identified here (e.g., poverty reduction, freedom, economic well-being, health and education) can be used a reference for which aspects should be used to select or monitor enterprises. However, the relevance of particular aspects to each enterprise is likely to differ depending on the context in which it operates and a good understanding of this context is also important and the application of these aspects into indicators against which the performance of particular enterprises can be measures still requires further work.

2.2 Principles of Sustainable Development

Sustainable development was originally developed as the broad concept of "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). However, this general definition is open to much interpretation. It is still problematic to assess a particular situation and determine whether or not it represents sustainable development and much work has been done to identify the characteristics that sustainable development can have in different contexts. For example, the concepts of human needs and development (both being part of the original definition) have, themselves, been subject to much debate (Kirkby et al., 1995).

In practice, the concept of sustainable development is interpreted in a variety of ways. These practical interpretations are usually in the form of general guiding principles or policy goals aimed at achieving sustainable development. According to Kirkby et al., (1995), 70 definitions of sustainable development were in existence in 1995. Presumably, many more have appeared since then. Determining which definition is the most appropriate for use in this study or developing some sort of unifying definition is difficult, potentially impossible and certainly not possible here. However, some relevant interpretations of the concept that could offer guidance in pursuit of the research objectives are provided below.

Our Common Future (WCED, 1987), which provided the original definition of sustainable development listed seven proposals for achieving sustainable development: revive growth,

change quality of growth, meet basic needs, stabilise population, conserve and enhance resources, reorient technology and manage risk and integrate environment into economics (Kirkby et al., 1995). These principles are intended for use at a policy level and applicability to enterprises was not originally considered.

The Rio Declaration on Environment and Development, an outcome of the United Nations Conference on Environment and Development (UNCED) in 1992, comprises 27 principles of sustainable development aimed at the national policy level. *Agenda 21*, another outcome of the UNCED in 1992, is considered a broad action plan for achieving sustainable development and categorises necessary action as follows (UNEP, 2002):

- Social and economic issues such as international cooperation; combating poverty, changing consumption patterns, demographic dynamics and protecting and promoting human health;

- Conservation and management of resources including issues such as protection of the atmosphere, deforestation, desertification, drought, rural development, freshwater resources, oceans, toxic chemicals and hazardous wastes.

- Strengthening the role of major groups such as women, children, indigenous people, NGOs, local authorities, business, industry, scientists, the technological community and farmers;

- The means of implementation including financial resources and mechanisms, technology transfer, education, public awareness, training, institutional arrangements, legal instruments and mechanisms, information and decision-making.

Although not directly applicable to enterprises, these principles and action areas do provide guidance in the issues of importance for sustainable development and enterprises could conceivably use the guidelines in developing company policy.

A more recent example of principles of sustainability is produced by the Natural Step organisation, which developed four principles of sustainability. The Natural Step contends that in order for a society to be sustainable, nature's functions and diversity are (TNS, 2003):

- Not systematically subject to increasing concentrations of substances extracted from the Earth's crust;

- Not systematically subject to increasing concentrations of substances produced by society;

- Not systematically impoverished by over-harvesting or other forms of ecosystem manipulation; and

- Resources are used fairly and efficiently in order to meet basic human needs world wide.

It is not specified how these principles should be incorporated into the decision-making processes of businesses or government, although it is intended that all four aspects identified above should be monitored in some way (e.g., development of context specific indicators) and form the basis of decision-making for sustainable development (TNS, 2003). While these principles are relatively specific and therefore easier to apply to specific enterprises,

they exclude aspects that are generally associated with the concept of sustainable development, such as social welfare, or economic sustainability.

The United Nations has recently developed a set of goals (e.g., eradicate extreme poverty and hunger, achieve universal primary education etc.), known as the Millennium Development Goals (MDGs) that are intended to provide measurable objectives for sustainable development (UNDSD, 2002). Considering energy systems (an important aspect of the REED enterprises), the World Energy Assessment, established by the UNDP, UNDESA (United Nations Department of Economic and Social Affairs), The United Nations Industrial Development Organization (UNIDO) and the World Energy Council, provides the following characteristics of sustainable development (UNDP, 2000):

- Eradicating poverty;
- Reducing relative income gaps;
- Providing universal access to energy;
- Increasing affordability of energy;
- Reducing adverse health impacts of energy;
- Reducing air pollution;
- Limiting long-lived radionuclides;
- Limiting toxic materials;
- Limiting greenhouse gas emissions;
- Raising indigenous energy use;
- Improving supply efficiency;
- Increasing end-use efficiency; and
- Accelerating technology diffusion.

Putting these goals into the context of energy, the United Nations has developed a Framework for Action on Energy that included 17 action areas for energy. These action areas are broadly consistent with the UNDP criteria with the addition of implementing better transportation practices and systems in mega cities, promoting new technologies for transport and progressively increasing the contribution of renewable energy mix of all countries (UNDSD, 2002). These principles are again aimed at the national policy level, although they could feasibly be adapted to the assessment of enterprises.

Considering energy services specifically, the UNDP recommends that energy services should be accessible, affordable, adequate, of good quality, reliable, safe and provide the required service (UNDP, 2000).

Policy goals could also be seen as principles of sustainability and the UNDP has also identified a number of policy goals for energy policy as follows (UNDP, 2001a):

- Electricity for illumination;
- Availability of mechanical power and electricity for energy using productive devices;
- Availability of cleaner fuels and enhanced markets to address the thermal energy needs of women related to cooking, heating and food processing;
- Technology development and dissemination in sectors and applications where women are most active;
- Support energy service financing and credit facilities to promote energy-using business opportunities;
- Provide improved information on markets and consumer demand for energy products to assist women in becoming energy entrepreneurs;
- Support gender equity in all economic sectors, and the participation of women and women's groups in national and local policy formation processes; and
- Remove barriers to the full participation of women in economic social and political life.

Assessment of progress towards the general guiding principles or policy goals aimed at achieving sustainable development is often achieved through the use of indicators. Indicators of sustainable development are discussed in Section 2.2.1.

2.2.1 Indicators of Sustainable Development - Sources of Further Information

After certain characteristics of sustainable development are identified, it is conceivable that different situations (or in this case enterprises or development interventions) can be evaluated comparatively with regards to progress towards sustainable development. It is much more difficult, probably impossible, to be able to provide an absolute measure of sustainable development. Although, by selecting the most promising option, the best possible progress can be made. It is a case of knowing the way, but not knowing whether you have arrived.

The development of indicators for progress towards sustainable development has been the focus of a number of organisations. Based on a review of available literature, and excluding the monitoring of enterprises (discussed in Section 2.3) indicators can be broadly categorised as either addressing the community or country level. Some relevant examples of each of these categories of indicators are listed below.

Community Level Indicators

As an attempt to generalise the indicators of relevance for communities, The International Council for Local Environmental Initiatives (ICLEI), has developed a list of 70 suggested indicators based on a study in 21 cities in 13 countries, including Africa (ICLEI, 2000). This set of indicators addresses the broad issues of governance, climate change and freshwater management which are considered to be of mutual relevance for these communities (ICLEI, 2000). The New Economics Foundation (NEF) (1998) provides the indicators used by 34

United Kingdom communities in the monitoring of their progress towards sustainable development.

Country Level Indicators
Country level indicators have been developed by many organisations. The United Nations' Commission on Sustainable Development (CSD) has developed a list of more than 130 indicators that can be used to track a country's progress towards sustainability (UNDSD, 2003). The Organisation for Economic Co-operation and Development (OECD) has developed a list of 34 indicators with the same objective (OECD, 2001a). Both of these organisations consider environmental, social and economic objectives.

Looking more specifically at energy related issues, country level indicators have also been developed specifically for energy systems. The International Atomic Energy Agency (IAEA) together with the International Energy Agency (IEA) has developed a set of indicators for energy sustainability based on 16 sustainability-related issues considered important for energy (see Table 2-1). From these 16 issues, 41 indicators have been developed, of which 23 are core indicators and a number of these indicators are the same as for the OECD and CSD indicators (IAEA & IEA, 1999) mentioned above. The core indicators are related specifically to energy use (e.g., end-use energy prices) whereas the non-core indicators do not relate specifically to energy (e.g., GDP per capita).

Note that the issues identified in Table 2-1 are not exhaustive and do not include other issues that could be associated with energy use such as energy service disparity and the fraction of national imports used to service energy requirements.

Table 2-1: Example of Sustainability Issues Linked to Energy Use (IAEA & IEA, 1999)

Social dimension	Economic dimension	Environmental dimension
Energy disparities Energy affordability and accessibility	Economic activity levels Energy production, supply and consumption Energy pricing, taxation and subsidies End-use energy intensities Energy supply efficiency Energy security	Air pollution Water pollution Wastes Energy resource depletion Land use Accident risks Deforestation Global climate change

Helio International, an NGO which focuses on measuring the sustainability of energy policy, has developed a more condensed list of eight indicators that can be applied on a national level (HI, 2003).

The OECD has also produced a list of indicators, addressing 15 sustainability objectives, for assessing whether sustainability concerns are being successfully integrated into energy policy (HI, 2003).

2.2.2 Concluding Remarks

This short listing of interpretations of sustainable development shows that it is a concept that is usually applied at a national level. However, attempts have been made to operationalise the concept at an enterprise level in the form of enterprise-focussed principles. However, these attempts tend to focus on specific aspects of the broad concept, and while they gain in

terms of applicability, tend to lose in terms of inclusiveness. In any case, even the general principles could be adapted for the use in assessing the non-financial impacts of enterprises, or can be used in the formulation of enterprise policy, and do at least provide guidance for the types of issues that should be assessed.

2.3 Monitoring and Management of Non-Financial Impacts within Enterprises

The monitoring management of non-financial aspects are often an important part of the overall management of private enterprises. The literature provides some guidance for private enterprises on how to manage and monitor non-financial aspects and this guidance is therefore potentially useful for the monitoring of development projects involving the support of private enterprises. This section summarises the relevant aspects of environmental management systems (Section 2.3.1), management theory (Section 2.3.2), monitoring of non-financial performance (Section 2.3.3) and reporting guidelines (Section 2.3.4) that may be useful for the monitoring of the non-financial returns of REED-type enterprises.

2.3.1 Environmental Management Systems

A common method of incorporating non-financial aspects (albeit only environmental aspects) into the decision-making process of an enterprise is through the use of an Environmental Management System (EMS). The purpose of an EMS is to incorporate environmental aspects into the decision-making processes of an organisation (ISO, 1996). The implementation process of an EMS is illustrated in Figure 2-1. EMSs have been developed into a number of internationally applied standards, the key ones being the ISO (International Organization for Standardization) 14000 series, the EMAS (Eco-Management and Audit Scheme) and the BS (British Standards) 7750 standard (Brorson & Larsson, 1999).

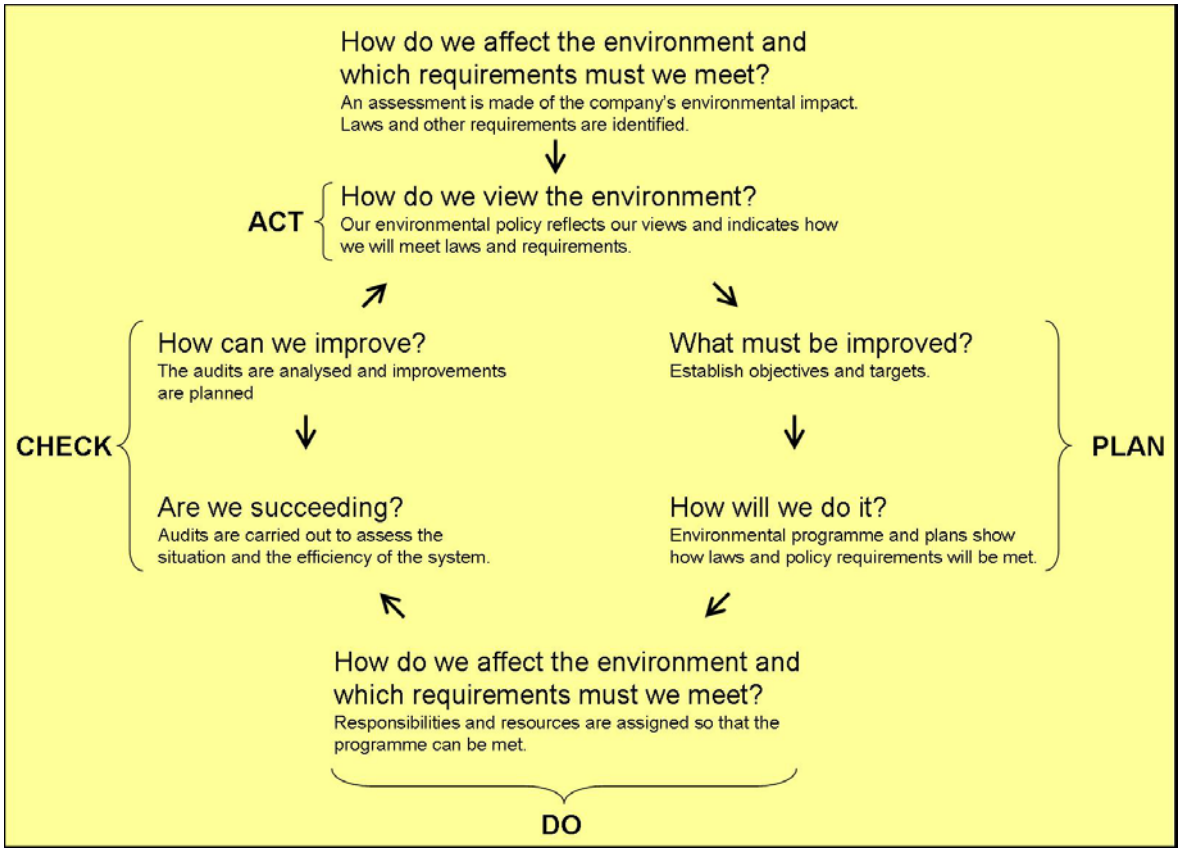

Figure 2-1: Basic Principles of an Environmental Management System (adapted from Brorson & Larson (1999))

Figure 2-1 shows that the implementation of an EMS is a dynamic process where environmental impacts are first identified together with laws and other requirements so that an environmental policy can be developed. Objectives and targets are then set which are met through the development of an implementation programme. Responsibilities and resources are assigned and efforts are monitored to assess the success of the programme. This monitoring is then used as a basis for review of the policy and the process is repeated. This methodology can be summarised as a "plan-do-check-act" methodology (Roberts & Robinson, 1998).

The standards themselves do not provide guidance for the selection of methods for identifying important impacts, but provide examples such as checklists, interviews, direct inspection and measurement, results of previous audits or other reviews but do require that an official procedure is in place (ISO, 1996). Examples of potential aspects (e.g., emissions to air, releases to water) are also provided for guidance (EC, 2001; ISO, 1996).

However, environmental management standards are often considered too costly or time-consuming for small to medium enterprises. In response to this issue, streamlined or staged standards, such as Project Acorn or BS 8555 have been developed. Project Acorn is based on the ISO 14000 series and the EMAS system in a staged approach. Enterprises are given recognition (i.e., certification) for each stage of implementation and are not required to implement the entire system thereby lowering the time and resources requirements (BSI, 2003). BS 8555 is a British standard that offers a similar staged approach for environmental management system certification.

A general criticism of environmental management systems is that they do not recognise good environmental performance, but simply recognise whether the required elements of the system are in place. The theory is that if a system is in place, that improved environmental performance will follow (Gleckman & Krut, 1997).

2.3.2 Management Theory

Poor performance in the management of non-financial aspects has been associated with financial risks and the management of non-financial aspects is considered by many to be important in meeting long-term financial objectives. Further, the good management of non-financial aspects has also been shown to lead to better quality goods and services (Bennett & James, 1999). In light of these beliefs, management tools that help to incorporate the management of non-financial aspects into company decision-making processes have been developed. Two of these management tools are the Balanced Scorecard and Environmental Management Accounting (EMA).

The Balanced Scorecard approach categorises the operations of an enterprise into four major perspectives: financial, customer, internal processes and learning and growth. Based on a set of interrelated indicators in each of these four perspectives, the performance of the business is monitored and reviewed. There are three possibilities to integrate environmental and social aspects into the Balanced Scorecard. First, environmental and social aspects can be integrated in the existing four standard perspectives. Second, an additional perspective can be added to take environmental and social aspects into account. Third, a specific environmental and/or social scorecard can be formulated (Figge, Hahn, Schaltegger, & Wagner, 2002). The broad underlying implementation approach is the same as for an environmental management system (i.e., plan-do-check-act) as described above.

Environmental management accounting (EMA) aims to allocate financial values to the environmental impacts of an enterprise to allow comparison with other financial aspects within the company during financial decision-making processes (EMARIC, 2003). By allocating financial amounts to environmental impacts, the real "value" of these impacts to the company is acknowledged. This approach is admittedly a company-centred approach and it is possible that environmental impacts that are important to society may not be considered important in terms of company management.

2.3.3 Monitoring of Non-Financial Performance

With regards specifically to evaluation of non-financial performance, guidance can be obtained from environmental management standards.

The ISO provides guidance for environmental performance evaluation in the international standard ISO 14031 (ISO, 1999). This guidance is structured similarly to environmental management standards in a dynamic and continuous process of planning (including the selection of indicators), implementation (collecting data, analysing and converting data, assessing information, reporting and communications), checking and acting (reviewing and improving the monitoring process).

In the planning phase it is recommended that an enterprise should base its monitoring and evaluation programme on the significant environmental aspects that it can control and over which it is expected to have an influence, its environmental performance criteria and the views of interested parties (ISO, 1999). The standard also provides a list of factors that could be considered (e.g., organisational structure, business strategy, environmental policy) that could be considered in developing the plan (ISO, 1999).

ISO 14031 also provides guidance on the selection of indicators by providing examples of approaches. These approaches may be (ISO, 1999):

- Cause and effect based – selecting indicators based on the cause of the impacts (e.g., poor maintenance as an indicator of increased emissions).

- Risk based – identifies important aspects and indicators by considering the risk associated with particular activities products or services. This approach can be further categorised into probabilistic risk (based on the probability of certain undesirable events), human health risk (based on the impacts on human health), financial risk (aspects that pose the greatest financial risk to the business) or sustainability risk (aspects that threaten the environment or the competitiveness of the organisation).

- Life cycle based – considering the lifecycle impacts associated with a particular product or service.

- Regulatory or voluntary initiative approach – based on regulatory or voluntary performance requirements.

2.3.4 Reporting Guidelines

Guidelines for environmental, sustainable development or corporate social responsibility reporting can also be used as guidance in assessing non-financial aspects. For example, the Global Reporting Initiative (GRI) was launched in 1997 as a joint initiative of the United States based non-governmental organisation, Coalition for Environmentally Responsible Economies (CERES) and the UNEP. The GRI provides a number of principles for reporting that are proposed to form the basis of a sustainable development reporting effort. These principles are summarised in Table 2-2. The principles of transparency, inclusiveness, auditability, sustainability context, timeliness and completeness relate mostly to the process of reporting itself and the principles of relevance, accuracy, neutrality, comparability and clarity are most relevant for the selection of indicators (GRI, 2002).

The GRI also specifies which economic, social and environmental aspects should be reported together with a standardised and relatively large (36 aspects each associated with one or more indicators) set of indicators. However, businesses are encouraged to adapt this set to the specific needs of their business (GRI, 2002).

Another similar reporting initiative is the AccountAbility initiative. This initiative is based on the three principles of materiality, completeness and responsiveness (ISEA, 2003). A report is considered material if it provides information that allows stakeholders to make informed judgments, decisions and actions. Materiality may be affected by compliance performance, policy-related performance, peer-based norms, stakeholder-based materiality or stakeholder views and perceptions (ISEA, 2003).

Completeness refers to the reporting organisation's ability to identify and understand its performance in the aspects identified as material (ISEA, 2003).

Table 2-2: Global Reporting Initiative Reporting Principles (GRI, 2002)

Principle	Description
Principles most Relevant for the Report Development and Reporting Process	
Transparency	Full disclosure of the processes, procedures, and assumptions are essential for credibility.
Inclusiveness	A systematic engagement of stakeholders to help focus and continually enhance quality of information.
Auditability	Information should be recorded, compiled, analysed and disclosed in a way that would enable internal auditors or external assurance providers to attest to its reliability.
Sustainability Context	Enterprise performance should be placed in the larger context of ecological, social, or other limits or constraints, where such context adds significant meaning to the reported information.
Timeliness	Information should be provided on a regular schedule that meets user needs.
Completeness	All information that is material to users for assessing enterprise's economic, environmental and social performance should be available in a manner consistent with the declared boundaries, scope, and time period.
Principles most Relevant for the Indicator Selection Process	
Relevance	Relevance is the degree of importance assigned to a particular aspect, indicator, or piece of information, and represents the threshold at which information becomes significant enough to be reported.
Accuracy	The accuracy principle refers to achieving the degree of exactness and low margin of error in reported information necessary for users to make decisions with a high degree of confidence.
Neutrality	The data set as a whole should strive to provide a balanced account of the enterprise's performance.
Comparability	Different enterprises with similar characteristics should be comparable in terms of performance. The enterprise should maintain consistency in the boundary and scope of its data set, disclose any changes and re-state previously reported information.
Clarity	Awareness of the diverse needs and backgrounds of stakeholder groups should be maintained. Information should be made available in a manner that is responsive to the maximum number of users while still maintaining a suitable level of detail.

Responsiveness relates to whether the enterprise has responded adequately to stakeholder concerns, policies and relevant standards, and adequately communicated these responses in its report (ISEA, 2003).

Another relevant initiative was developed in the United Kingdom through a joint effort between a number of government departments, research institutions and private companies and is known as the SIGMA Guidelines (BSI, FF, & ISEA, 2003). The SIGMA guidelines are based on the premise that organisations need to actively manage natural capital (the environment), human capital (people), social capital (social relationships & structures), manufactured capital (fixed assets) and financial capital (profit and loss, sales, shares, cash) to make progress towards sustainable development (BSI et al., 2003).

This premise is supplied together with a management framework similar to standard environmental management frameworks and, according to BSI et al., (2003) consists of a continuous process of leadership and vision (define the vision for sustainability and ensure leadership support for it), planning (decide what needs to be done to improve performance),

delivery (improve performance), monitoring, review and reporting (check that performance is improving and communicate the results).

The World Business Council for Sustainable Development Reporting Guidelines (WBCSD, 2003) and The Copenhagen Charter (E&Y, 1999) are two further sources of similar guidance. Both these organisations provide the framework for an ongoing reporting process similar to those described above.

There are many further examples of principles or guidelines from the field of corporate social responsibility (Magnusson & Norén, 2002). These guidelines tend to focus on providing isolated operating principles (e.g., the company shall not engage in or support the use of child labour) but generally do not address how this principles should be implemented other than to specify that a system should be in place or that certain personnel (e.g., senior manager for health and safety) should be appointed.

2.3.5 Concluding Remarks

The incorporation of non-financial aspects into the decision-making processes of enterprises is achieved in a variety of ways. However, as a simplification of these processes, it can be said that at the heart of the various models and guidelines reviewed here is a process where, initially objectives and targets are set based on the issues to be considered important within a particular context. Progress towards targets is then measured, using both quantitative and qualitative indictors, and based on this progress, and a review of the process as a whole, modifications are made before continuing the process. In an environmental management system, the objectives and targets are determined by issues considered important in terms of legislation and the environmental policy of the company. In CSR-based processes, these issues are determined by the social policy of the company and are often guided by a set of social principles. However, the issues of importance for the company may not be the issues of importance for society and may not reflect proper progress towards sustainable development.

2.4 Test Enterprise Analysis Methodology

The operation of an enterprise leads to a number of non-financial returns. When non-financial returns of enterprises are assessed on an ongoing basis, the selection of impacts to be measured is determined by a combination of which returns are important for the business (e.g., in terms of competitiveness) and which returns are important for society (e.g., through legislation).

Furthermore, in the context of a development intervention, the support or establishment of a particular enterprise will have non-financial impacts throughout many different and interrelated aspects of society. The importance of these impacts should, in theory, align with the objectives of the development programme, which are established by a good understanding of the society in which it operates and a practical understanding of the concept of sustainable development. However, development and sustainable development are two multidisciplinary (but converging) concepts that have many different interpretations and are difficult to operationalise. A review of the literature has identified a pool of issues which could be considered important in the context of sustainable development in general, and from an energy-related perspective.

The ongoing assessment of non-financial aspects due to enterprises typically takes the form of a "plan-do-check-act" methodology (see Section 2.3) in which non-financial impacts are

identified and assessed, through the selection of objectives and targets relevant to the enterprise. Progress towards these objectives and targets is measured through the selection and application of indicators. Criteria to assist in the selection of these indicators are found in the literature. A review and subsequent modification of the process is performed regularly. This study addresses the first three stages of the process and is therefore structured as follows:

1. An identification of non-financial impacts.

2. Assessment of the non-financial returns.

3. Review of the process (including guidance for future assessment).

The usual first stage of the process, the setting of objectives and targets for the enterprises, is not within the scope of this study and is therefore excluded from this methodology.

2.4.1 Identification of Non-Financial Impacts

Identification of non-financial impacts should be performed with a good knowledge of the enterprise. This study did not sufficiently study contextual factors to determine whether particular non-financial impacts are of significance. Therefore, no judgement is made regarding the importance of the particular non-financial impacts and all identified impacts are considered for further assessment. This is done based on the assumption that those with good knowledge of the enterprise would identify the important impacts in a given context.

It is important to note that the assessment of non-financial impacts is usually done within the context of a broader enterprise management process, at issues which affect the ongoing survival of the business should normally be considered. The influence of non-financial issues on the ongoing enterprise management process is not considered as it would require a level of knowledge for each enterprise that is not obtained through the methods used here.

2.4.2 Assessment of the Non-Financial Returns

The assessment of non-financial impacts requires the selection and application of quantitative and/or qualitative indicators. These indicators should be selected based on a set of predetermined criteria and considering practical constraints such as time, labour requirements and data availability. As a starting point, this study uses the criteria for indicator selection from the Global Reporting Initiative listed in Table 2-2, Section 2.3, to aid and evaluate indicator selection. These criteria are considered to represent the current best practice in indicator selection and are used in a qualitative manner as a reference point to assess the suitability of the indicators selected. The criteria are discussed, where relevant, in Section 3.2.

2.4.3 Review of the Process

The results of the assessment above and the subsequent limitations in the process guide the discussion regarding the suitability of the methodology used here and its suitability as a basis for the future selection and assessment of enterprises. The influence of the constraints identified throughout the process should be recorded and discussed.

3. Enterprise Analysis

3.1 Enterprise Description

Table 3-1 summarises the case studies analysed and lists the name of the enterprise, the country in which they operate, a description of the activity that the enterprises are engaged in and a summary of the financial assistance provided. Note that enterprise development support (as described in Section 1.1.4) was provided for all enterprises. A more detailed description of the enterprises and the type of support given to each enterprise is provided in Appendix A.

Table 3-1: Enterprise Descriptions and Type of Financial Assistance[3]

Enterprise	Country	Activity	Financial Assistance
KBPS	Zambia	Charcoal briquette manufacture	USD 75 300 loan, 5 y payback at 12.0% p.a.
RASMA	Zambia	Improved charcoal stove manufacture	USD 20 000 equity investment.
Ubwato	Zambia	Improved charcoal stove manufacture	First disbursement (already paid) USD 15 855 loan, 4.5 y payback at 5.0% p.a. Second disbursement (not yet paid) USD 15 000, terms not yet agreed. Third disbursement (not yet paid) USD 10 000, terms not yet agreed.
TSADC	Zambia	Solar bakery	USD 20 000 loan, 4 y payback at 5% p.a.
CWV	Zambia	Motor control equipment retailer	A loan of USD 22 300, 2 y payback period at 12.0% p.a.
BETL	Tanzania	Biomass energy producer	USD 50 000 loan, 4 y payback at 10% p.a.
Bagani	Mali	Jatropha platform operator	USD 15 170 loan, 5 y payback at 10% p.a.
USISS	Mali	Solar food drying	USD 19 665 loan, 5 y payback at 12.0% p.a.
AB Management	Ghana	Power factor correction equipment retailer	USD 122 400 loan, 5.5 y payback at 12.0% p.a.
Anasset	Ghana	LPG retailer	USD 38 000 loan, 4 y payback at 7.5% p.a.
GTEL	Ghana	Retailer of compact fluorescent equipment	USD 70 000 loan, 3.5 y payback at 7.5% p.a.
AME	Senegal	Solar hot water heater maintenance	USD 41 563 loan, 3 y payback at 11% p.a.
VEV	Senegal	Wind powered water pump maintenance	USD 17 831 loan, 5 y payback at 12.0% p.a.
La Esperanza	Honduras	1.2 MW hydro power station	USD 250 000 loan, 6 y payback period at 12.0% p.a.

[3] Note that enterprise development assistance (as described in Section 1.1.4) was provided for all enterprises.

Table 3-1 shows that 14 enterprises were studied from six different countries: Zambia, Tanzania, Mali, Ghana, Senegal and Honduras. A variety of businesses were studied with the only business type that occurred more than once being charcoal stove manufacturing. Financial support ranged from a USD 15 170 loan to a USD 250 000 loan. One enterprise was supported through an equity investment rather than a loan.

Table 3-2 shows the non-financial impacts and an indication of non-financial returns that could be estimated during this study. Note that the presentation of this information does not imply the suitability of the data for use as indicators, which is discussed in Section 3.2. In Table 3-2, if a particular non-financial identified above is not listed, no significant impacts of this type were observed or expected.

The following non-financial impacts were identified:

- Avoided deforestation or reforestation;
- Job creation;
- Waste utilisation;
- Avoided environmental impacts of traditional charcoal production;
- Avoided health/environmental impacts of traditional fuel use;
- Labour/time savings;
- Increased personal/household income;
- Electricity savings;
- Cost savings;
- Fossil fuel substitution;
- Empowerment of women;
- Electricity supply;
- Health benefits of reliable water supply; and
- Infrastructure improvement.

Section 3.2 below provides a summary of the issues facing the selection of indicators for each of the non-financial impact categories that were identified and provides some examples of indicators that may be used. Note that if a particular category of impact is not presented under a given enterprise, no significant impacts of this type were expected. The term "no data" implies that although impacts of a certain type are expected, no data were available to describe the impacts. Further descriptions of the enterprises, the type of development support given, explanations of all calculations and discussion regarding the non-financial benefits are given in Appendix A.

It should be noted that it became apparent during the analysis, that further work is required regarding the classifications of impacts. The impacts identified in Table 3-2 are, in many cases oversimplifications of the types of impacts that occur, or do not fully represent the actual outcomes of the intervention that are of interest. For example, empowerment of women is a complex concept involving, among other things access to education, health, time/labour savings and property rights and is unlikely to ever be adequately expressed in a single category of impact. The categories presented in this section were selected, based on the responses of interviewees and grouped to facilitate a manageable presentation of the results. A discussion of the suitability of each classifications is presented under each category where relevant, and more generally in Section 4.1.1.

Table 3-2: Summary of Case Study Results

Enterprise	Non-Financial Impacts[4]	Indication of Non-Financial Returns (if possible)[5,6]
KBPS	Avoided deforestation or reforestation	220 ha/y
	Job creation	5 direct fulltime, 24 in distribution network. Estimated potential for displacement of 140 traditional jobs[7]
	Waste utilisation	3500 t/yr of waste logs utilised
	Avoided environmental impacts of traditional charcoal production	2400 t/y of traditional charcoal production avoided.
RASMA	Avoided deforestation or reforestation	180 ha/y, cumulative
	Job creation	5 direct fulltime. Estimated potential for cumulative displacement of 100 traditional jobs/y[7]
	Avoided health/environmental impacts of traditional fuel use	Estimated emissions savings in (t/y, cumulative): TSP: 4.8, NO_x: 0.44, CO: 310, CO_2: 4900, CH_4: 16, NMHC: 13
	Labour/time savings	No data.
	Increased personal/household income	USD 3.0/month in 4800 households/y, cumulative, once stoves have been paid for.
Ubwato	Avoided deforestation or reforestation	230 ha/y cumulative
	Job creation	7 direct fulltime. Estimated potential for cumulative displacement of 140 traditional jobs/y[7]
	Avoided health/environmental impacts of traditional fuel use	Estimated emissions savings in (t/y, cumulative): TSP: 6.0, NO_x: 0.55, CO: 390, CO_2: 6100, CH_4: 20, NMHC: 16
	Labour/time savings	No data.
	Increased personal/household income	USD 3.0/month in 6000 households/y, cumulative, once stoves have been paid for.
TSADC	Avoided deforestation or reforestation	14 ha/y.
	Job creation	No data, not yet established. 1 indirect job loss estimated[7]
	Avoided health/environmental impacts of traditional fuel use	Assuming 100% charcoal use (t/y): TSP: 0.12, NO_x: 0.013, CO: 11, CO_2: 110, CH_4: 1.3, NMHC: 0.48
		Assuming 100% wood use (t/y): TSP: 1.2, NO_x: 0.017, CO: 4.0, CO_2: 240, CH_4: 1.5, NMHC: 1.2

[4] If a particular category of impact is not presented under a given enterprise, no significant impacts of this type were expected.

[5] See Appendix A – Case Study Summaries for further explanation of all calculations.

[6] The term "no data" implies that although returns of a certain type are expected, no data were available to describe the impacts.

[7] This is an exploratory calculation only (see Appendix A – Case Study Summaries).

Enterprise	Non-Financial Impacts[4]	Indication of Non-Financial Returns (if possible)[5,6]
CWV	Job creation	Three permanent employees. Casual labour is employed depending on variations in sales volume.
	Electricity savings	Average energy savings - 10%.
	Cost savings	No data.
BETL	Avoided deforestation or reforestation	No reforestation taken place yet.
	Job creation	Two additional positions to be created Potential for up to 1000 indirect jobs.
	Fossil fuel substitution	2500 MWh/month of heavy fuel oil currently displaced (expected to increase to 5000 MWh/month)
Bagani	Job creation	300-450 women using the platform for income generation. 2 male operators.
	Labour/time savings	30-110 households gaining benefit:: rice husking: 98% saving, Shea nut processing: 39% saving
	Empowerment of women	99% of customers are women (i.e. up to 450). Time savings allow more education and productive employment.
	Electricity supply	Between 3 and 10 customers/d.
USISS	Job creation	Six employees within the bakery. Further employees at the marketplace. No further data.
	Avoided health/environmental impacts of traditional fuel use	Displacement of traditional fuel use. No data regarding quantities currently available.
AB Management	Job creation	No data regarding direct employment. Potential for indirect employment through customer savings.
	Electricity savings	Average savings ~ 20%. Estimated greenhouse gas savings of up to ~ 31 000 t/y CO_2 equivalent.
	Cost savings	Customer savings due to reduction in electricity consumption. No data.
Anasset	Avoided deforestation or reforestation	810 ha/y.
	Job creation	No data regarding direct employment. Estimated potential for indirect displacement of 260 traditional jobs.[7]
	Avoided health/environmental impacts of traditional fuel use	Net emissions savings in (t/y): TSP: 38, NO_x: -4.4, CO: 2800, CO_2: 22000, CH_4: 380, NMHC: 130
	Labour/time savings	Potentially 2 700 beneficiaries. Daily household savings up to 4 h/d (i.e. up to 10 800 h/d).
	Increased personal/household income	Household savings (USD/month)[8]: -0.6 for charcoal users, -1.1 for firewood users, 3.6 for kerosene users.

[8] A negative saving implies higher monthly costs for using LPG.

Enterprise	Non-Financial Impacts[4]	Indication of Non-Financial Returns (if possible)[5,6]
GTEL	Job creation	11 permanent employees (3 managers, 1 security guard and 7 office/sales staff)
	Electricity savings	6.7 GWh/y to 32 GWh/y, cumulative.
	Cost savings	No data.
AME	Job creation	2 administrative officials, 2 technicians, 1 commercial assistant and 1 house keeper. No significant indirect employment effects are expected.
	Fossil fuel substitution	Approximately 250 MWh/y of fossil fuel based electricity.
VEV	Job creation	15 employees: 3 administrative, 10 technical, 1 driver and 1 housekeeper. Indirect jobs for entrepreneurs that sell water from the public pipes - no data. Time/labour saving benefits (see below) => indirect employment effects – no data. Greater demand for locally-made materials => job creation - no data.
	Labour/time saving	Saving of time and labour associated with water carrying. Approximately 100 pumps under service at the moment, servicing a population of between 30 000 and 100 000 people. Savings of between 12 000 and 40 000 h/d.
	Increased personal/household income	Average net village income between approximately USD 320/y and USD 635/y × 100 => between USD 32 000/y and USD 63 500/y net savings increase. Enhancement of agricultural output by utilising water for irrigation and better upkeep of livestock => increased income – no data.
	Fossil fuel substitution	Maximum of 438 000 kWh/y of fossil fuel generated electricity.
	Health benefits of reliable water supply	Reduction in transmission of water-borne diseases – no data. Agricultural productivity => better nutrition – no data.
La Esperanza	Avoided deforestation or reforestation	27 000 trees planted. No data regarding equivalent area.
	Job creation	40 temporary jobs – construction. 10 permanent jobs.
	Fossil fuel substitution	7.5 GWh/y non-fossil based electricity produced.
	Electricity supply	Commitment to support rural electrification conditional upon profitability. No data.
	Infrastructure improvement	Improved access to services. No data.

3.2 Assessment of Non-Financial Returns

This section provides commentary on the process of assessing the non-financial returns for the non-financial impacts identified in Section 3.1. Some discussion of the results is provided, where it leads directly from the process of analysis used in this study. Please refer to Appendix A for further commentary regarding the assessment of non-financial returns for particular enterprises. More general discussion is provided in Section 4.

3.2.1 Avoided Deforestation or Reforestation

Forest is an important natural resource in a number of the countries considered as part of this study. The depletion of this forest can lead to environmental impacts such as loss of biodiversity, erosion and salinity. There may also be impacts nearby communities that use the forest for fuel if collection becomes more difficult or time consuming.

Seven of the enterprises were associated with this type of return. Area was used as an indicator in six cases and returns ranged from 0 ha/y (i.e., no reforestation taken place yet) to 810 ha/y of avoided deforestation due to LPG substitution. Sufficient information was not available to estimate an equivalent area for the remaining enterprise which had planted 27 000 trees, although it does seem reasonable to convert this to an area in future. Two of the enterprises were associated with cumulative returns (e.g., 230 ha/y cumulating annually).

The contribution of the enterprises to the potential outcomes of deforestation (e.g., loss of biodiversity) was not possible to estimate in this study.

Estimates of avoided deforestation where based on savings in charcoal consumption. These savings where either based on charcoal savings due to improved stoves, more efficient industrial production of charcoal, substitution with LPG or renewable energy. The accuracy of the information used to estimate returns probably varied significantly because of the variety of sources used, although crude (e.g., orders of magnitude) comparison between enterprises is probably possible.

Also, the importance of deforestation as an issue varies between contexts. For example, it was found in this study that in Zambia, deforestation due to charcoal production might not be as significant as in other countries because of relatively sustainable charcoal production practices. This implies that qualitative information describing the importance of the impact is necessary to be supplied together with anything quantitative.

An advantage with using the area of deforestation avoided as an indicator is that it is relatively easy to estimate for most enterprises. It also provides a clear, comparable measure (at least between orders of magnitude) that is likely to be understood by many. Further, if the operations of an enterprise lead to deforestation, such impacts could be recorded as a negative return.

The amount of financial support is useful to record as it provides a basis for calculating the non-financial return on investment (e.g., ha/USD invested). However, the importance of the financial basis (e.g., through standard of living, purchasing power etc.) is also likely to vary between contexts.

The mass of wood saved could also have been used as an indicator, although area, which is often used to describe the impacts of deforestation, was considered more appropriate in this case.

3.2.2 Job Creation

Based on the results of this study, job creation is likely to be an important benefit in most development work and is present to varying degrees in all of the enterprises studied. The creation of a job leads to outcomes such as more income, increased well-being or reduced vulnerability, which further influences the level of assets in a particular community. The total benefits depend on the type of job (e.g., the sector, working conditions, income generated) and the number of jobs created.

In quantifying these benefits, the outcomes (e.g., level of increased well-being) should, ideally, be the focus of monitoring efforts. However, in practice, it was difficult to determine the contribution to community benefits from particular enterprises and more labour intensive methods (e.g., community surveys) are likely to be required. From the direct impacts of the enterprise, it was only possible to collect information regarding the number of jobs created together with, in some cases, descriptions of the type of jobs created. Where data were available, the number of created jobs ranged from 15 direct employees to the potential for up to 1000 indirect jobs. The potential for negative returns, or indirect job losses (up to 240), was also observed, although these estimates require further verification. It does seem reasonable to be able to collect similar data on a regular basis, although estimations become increasingly difficult further down the supply chain. Indirect job creation or losses are therefore associated with relatively high uncertainty. The amount of financial support is also useful to record as it provides a basis for calculating the non-financial return on investment (e.g., no of jobs created/USD invested). However, care should be taken when using such a measure, as the importance of the financial basis (e.g., because of differences in standard of living, purchasing power etc.) is also likely to vary between contexts.

The number of jobs created is still a relevant indicator provided it is known that jobs are not being created at the expense of other employment and that some knowledge already exists regarding the appropriateness of benefits of particular jobs. Job creation objectives are likely to be targeted (i.e., particular sectors, women) so it is important to have qualitative information regarding the type of employment that has been generated. The number of jobs is also easily communicable and comparable between enterprises.

It is most important to be able to compare enterprises in terms of levels of orders of magnitude (e.g., an enterprise that creates approximately 10 jobs against one that creates approximately 100 or 1000) and accuracy beyond such a level is not essential.

3.2.3 Waste Utilisation

Waste production is an indicator of inefficient production and is relevant to assess if the preservation of the resource being utilised is an important issue. In the cases analysed here, it was unlikely that inefficient production was an explicit development issue. In other cases, this would of course depend on the type of waste (e.g., high levels of toxic waste production would probably cause some concern). However, the waste utilised in this case was wood waste and its utilisation is not in itself, likely to be an important development issue, unless deforestation is considered important. See Section 3.2.1 for issues concerning the assessment of the non-financial returns related to deforestation. It seems, therefore, that waste utilisation is an impact that may be better considered under other impact categories (e.g., toxic releases, avoided deforestation, avoided gaseous releases from combustion or decomposition).

In the case studied here, the mass of waste utilised (3500 t/y) could be collected. If the assumption is made that waste utilisation is an important issue, then this information is a clear and relevant indicator. However, important impacts of waste production are usually specific to the type of waste it is therefore important to know which type of waste is being utilised. It is difficult to compare potential impacts from different types of waste or different potential uses of waste that is utilised. An indicator relating to the specific impacts of unutilised waste could not be selected. If considered important for a particular context, a further indicator relating to the impacts of unutilised waste (e.g., emissions due to the burning of waste firewood in this case) could be selected.

Using the mass of utilised waste as an indicator is useful for comparability between enterprises and is relatively straightforward to collect. Two significant figures of accuracy were used in this case and seemed an appropriate level for comparison.

If waste is produced as a result of the operations of an enterprise, this should also be considered. This is however, a difficult issue to address as some sort of waste is produced by any enterprise, and it is unlikely to be possible to monitor all waste streams. Also, waste production may be addressed under local environmental regulations. However, if a waste production related issue is considered important in the context of a particular issue, it should also be monitored.

The level of financial support may also be useful to record if comparing returns between companies on a financial basis (e.g., mass of waste utilised/USD invested). However, this should be done with care, as a financial basis has different meaning in different contexts (e.g., through standard of living, purchasing power etc.).

3.2.4 Avoided Environmental Impacts of Traditional Charcoal Production

Traditional charcoal production affects level of natural capital through processes such as deforestation (see Section 3.2.1), combustion emissions to air (from wood burning and vehicle emissions and leading to a variety of regional level environmental effects), changes in forest mineral composition and road damage to forested areas (which both affect forest productivity among other things). These impacts are quantifiable, although more detailed studies than performed here are required. Also, the impacts (e.g., soil deterioration) due to single enterprises would be difficult to isolate and is most likely best left to monitoring efforts outside the scope of one enterprise. It should also be noted that the importance of these impacts appear to vary significantly depending on the community or country and the environmental impacts of charcoal production may not be a significant issue.

The best indicator available in this study was the amount of traditional charcoal production avoided. To be able to compare between enterprises, it must be assumed that a given amount of avoided charcoal production leads to a similar impacts in different contexts. This indicator was calculated for the one relevant case in this study (2400 t/y), and based on this estimation should not present significant data gathering requirements in future. However, this indicator can only be compared with other enterprises that save charcoal and not those which may lead to the same impacts (e.g., deforestation) in other ways. This problem requires further work and is discussed in Section 4.1.1.

Some indicators of the final impacts (e.g., emissions to air avoided) could also be used, although the importance of these impacts should be established first. The mass of traditional

charcoal production can most likely form the basis of further more detailed impact estimations at a later date.

The assumption of comparability may not be correct in many cases and the importance of environmental impacts of traditional charcoal production are likely to differ depending on the context, so it is important to attach qualitative information regarding the importance of specific impacts in a particular contexts.

It should also be noted that although potentially important, rebound effects could not be considered. For example, it may be that a particular intervention, although more efficient, increases the consumption of charcoal because it is cheaper or easier to acquire. Further studies of community behaviour are required to appropriately define these effects.

The cost effectiveness of a particular intervention can also be assessed by estimating returns on the basis of money invested (e.g., mass of traditional charcoal production avoided/USD) invested) although as mentioned previously, the value of such a basis is also influenced by qualitative factors.

3.2.5 Avoided Health/Environmental Impacts of Traditional Fuel Use

The use of charcoal for cooking in the home can lead to health impacts to residents, usually women and children. However, the level of impact depends on differences in ventilation, housing structure, fuel type and cultural habits (e.g., cooking outside). Therefore, knowledge regarding these factors is required to properly assess the impacts of a particular intervention regarding cooking impacts.

Charcoal consumption can also lead to emissions of pollutants that cause environmental damage of regional or global concern. The importance of these impacts to a particular community or country is a context-specific issue. For example, if produced sustainably, charcoal may emit zero net greenhouse emissions.

Four enterprises in this study were associated with this type of return. Two enterprises were involved in the manufacture and retail of more-efficient charcoal stoves, and two displaced the use of charcoal for cooking, through solar energy or LPG. Considering the contribution of individual enterprises, it was only possible to estimate the level of charcoal savings or the subsequent emission savings of pollutants of concern commonly associated with charcoal cooking. However, there is often significant unreliability associated with these estimates, due to factors such as unreliable manufacturer claims, behavioural factors (e.g., cooking times), fuel characteristics and inherent unreliability in emission factors and these factors should be considered when making comparisons.

Without specific knowledge of the cooking habits or importance of environmental issues of the communities in question, emission savings are not adequate to assess final health/environmental impacts of the enterprises. Also, this indicator can only be compared with other enterprises that save charcoal and not those which may lead to the same impacts (e.g., deforestation) in other ways. This problem requires further analysis and is discussed in Section 4.1.1.

However, it may be prudent to collect information regarding emission savings while important contextual information (e.g., cooking methods) is collected. For example, given the growing importance of climate change impacts, it may be wise to collect annual estimates of greenhouse gas emissions savings, or information that allows these emissions to be

estimated (i.e., charcoal savings). This information is relatively easy to collect if based on reliable emission factors that use charcoal consumption as a basis. Charcoal consumption savings were collected relatively easily in this study. Further work needs to be performed to determine which pollutants are of general concern and which emission estimation techniques are relevant before this information can be used to compare enterprises.

Information regarding the amount and type of financial support is also likely to be useful in future as a basis for assessing the cost-effectiveness of interventions.

Of course, if an intervention leads to health/environmental impacts of concern, these could be recorded as a negative return.

3.2.6 Time/Labour Saving

Time or labour burdens are often considered important restrictions to development. Time or labour savings are outcomes that allow people more freedom to pursue their lives in the way that they feel is most appropriate. The impacts due to these savings depend on the individual's preferences together with other characteristics of the society (e.g., policies, institutions, processes, vulnerability and assets) in which they live. These choices could not be measured in this study, and are likely to require more labour intensive methods such as community surveys.

It was, in some cases, possible to make estimates of time savings due to a particular enterprise, although the accuracy (and usefulness) of these estimates for a particular community was questionable. Time/labour savings data, where available, varied from the number of households positively affected (30-110) to a total daily time saving (10 800 to 40 000 h/d). However, these types of estimates may be reasonable for comparison between enterprises, as it can be useful to know simply whether an enterprise provides no, some or significant time saving benefits for a community, especially if time or labour savings are considered as important objectives.

A good starting point for assessing time/labour saving benefits may be a subjective assessment of whether an enterprise provides no, some or significant time saving benefits to a community. These categorisations will allow comparability, provided that they are defined clearly. Further qualitative information should be added to describe the nature of these benefits and quantitative information can also be added if available and easily calculable.

If an intervention adds to the time/labour burdens of a community, this should also be recorded together with information regarding levels of financial assistance to enable assessments of cost-effectiveness.

3.2.7 Increased Personal/Household Income

Wellbeing is usually associated with, although not exclusively, an increase in financial capital. Using the language of the sustainable livelihoods approach, increased financial capital provides an individual with more freedom in selection of livelihood strategies. This selection of strategy is influenced by personal preferences together with other characteristics of the society (e.g., policies, institutions, processes, vulnerability and assets). These choices could not be measured in this study.

However, potential monetary savings due to the enterprises could be estimated and provide a clear and useful basis for comparison between enterprises, provided that the importance of increased household in a particular context is understood. Therefore, it is important to know

the beneficiaries of cost savings and whether these beneficiaries are consistent with development objectives (e.g., targeting the rural poor). It is also important to know how important a particular level of cost savings is in a particular context (e.g., fraction of household income saved).

Further, it is important to note that savings may not be immediate (e.g., goods purchased on credit), and this should be taken into account when making estimates.

In some cases it was possible to estimate average household or personal savings due to the enterprise together with the number of households/individuals affected. These savings varied from a small increase in cost (USD 1.1/month for households switching from firewood) to a saving of USD 3.0/month in 6000 households. The number of households or the average village size was not always available, so direct comparisons were not possible in all cases. It should not require significant additional effort to obtain the necessary information. Savings data require further information regarding the importance of these savings for a particular community (e.g., community needs/wealth, purchasing power of savings gained) to be a useful basis for decision-making. The level of financial assistance could also be used as a basis for estimates of cost-effectiveness.

3.2.8 Electricity Savings

Businesses that use significant amounts of electricity can benefit through the installation of electricity conservation devices. Savings in electricity lead to cost savings which can increase the amount of capital available to a business allowing it to grow (see Section 3.2.9). Also, reduction in electricity consumption can be beneficial to a country where the environmental impacts of electricity production (e.g., combustion emissions from coal combustion leading to damage to agricultural crops) are of importance. Energy efficiency may also be a policy goal of a particular country so as to save money on imports or in the general interests of energy security.

The contributions of the two enterprises to the end use impacts of electricity consumption were too difficult to estimate in this study. Electricity savings (6.7 GWh/y to 32 GWh/y) was estimated in one case and average energy savings in percentage terms was estimated for the other enterprise. It is therefore difficult to compare these two enterprises until further information becomes available.

A comparable indicator (e.g., GWh/y saved) should be presented together with contextual information regarding the importance of energy efficiency outcomes for a particular community.

Enterprises that significantly increase the energy burden on a country should also be monitored, although the boundary between what should be considered under either normal environmental management practices, national policy and the monitoring of a development intervention is still unclear.

The recording of information regarding the level of financial support may also be useful to allow for further calculations of cost-effectiveness, should they be needed.

3.2.9 Cost Savings

Some interventions (e.g., the sale of energy efficiency devices) lead to cost savings for commercial customers. These savings can be passed on to the consumer in the form of lower prices, can allow the business to grow through the availability of more financial capital or can provide other benefits such as job creation.

However, keeping track of all possible outcomes was not possible in this study. Also, no information regarding cost savings to customers was found. Further, it is questionable whether such information can provide any indication of the potential beneficial outcomes or whether cost savings can be calculated as directly attributable to a particular intervention. Effects such as administration costs, other efficiency gains in the company etc. may complicate the issue.

No method of monitoring cost savings within enterprises was found to be suitable and it is considered in this case that it the focus of monitoring should be on the outcomes, with the monitoring of these outcomes (e.g., job creation) either being the subject of other aspects of an enterprise monitoring regime or other monitoring efforts.

3.2.10 Fossil Fuel Substitution

In this section the term "substitution" refers to the substitution of commercial or industrial use of fossil fuel. Household use is discussed in Section 3.2.5.

A number of the enterprises are substituting for the prior use of fossil fuels with renewable sources of energy. Fossil fuels are a natural resource and the substitution of fossil fuel consumption preserves this natural capital or reduces reliance on imports. Also, the consumption of fossil fuels leads to environmental impacts that may influence other levels of natural capital (e.g., quality of agricultural land affected by coal-fired combustion) or the vulnerability of a community (e.g., air-pollution damaged cropland).

The level of natural capital preserved (e.g., amount of fossil fuel displaced) by a particular enterprise could be relatively easily collected and was done so during this study. However, this indicator is only comparable with other fossil fuels and not other practices that can lead to similar impacts (e.g., deforestation leading to greenhouse gas emissions).

The avoidance of particular impacts associated with the use of fossil fuel is more difficult. It is difficult, for example, to determine the benefits to cropland due to the displacement of fuel oil substitution. The emissions leading to the impacts could also be relatively easily estimated based on fossil fuel consumption at a particular enterprise.

Although the substitution of fossil fuel is considered an important aspect of the policy many national governments, the contribution of particular enterprises to many of the benefits associated with fossil fuel substitution (e.g., less financial reliance on imports, energy prices, energy security) are not easily measured. However, some aspects such as pollutant emissions, amount of energy substituted (i.e., amount of natural capital preserved), could be used in some cases to infer these impacts, and are relatively easily quantified.

A common, comparable and measurable indicator of the energy resource is the potential energy output saved (e.g., kWh/y, MWh/y, GWh/y). The fossil fuel energy use saved was available for the enterprises studied here. The relevance of this indicator depends on the area of interest that it is trying to reflect. A measure such as kWh may be useful if renewable energy electricity generation is a goal, as it reflects the level of service provided (i.e.

electricity). However, if, for example, reliance on imports is of interest relevant, then the amount of fuel (e.g., tonnes/y or GJ/y) may be a better indicator.

Therefore, due to the differing impacts depending on the type of fuel used and the type of use, qualitative information on the type of fuel and type of process is also important to record.

These indicators do not address many of the environmental impacts associated with fossil fuel use, and it is unlikely whether the contribution of particular enterprises to these impacts could be measured.

The level of financial support could also be recorded to allow for potential cost-effectiveness estimations.

Negative fossil fuel substitution effects are unlikely to be relevant for REED-type enterprises, as an enterprise that displaces non-fossil fuel based energy is highly unlikely to be accepted into the programme.

3.2.11 Empowerment of Women

Policies and processes affecting women are often the specific target of development work. Empowerment is a subjective concept and its measurement is as subjective and can include such aspects such as policies, cultural practices, levels of income and time/labour savings. A holistic assessment of such impacts was not possible in this study.

However, it was possible to estimate whether women are likely to be positively affected by the implementation of a particular enterprise (in this case the Jatropha Platform), due to the results of previous similar work. It was also possible to make an approximation of the number of women affected by the platform. The number of women affected is a clear, comparable and collectable indicator (up to 450 in this case) but lacks important context in terms of the types of impacts and the level of benefits. There are concerns about the reliability of estimates, what constitutes a significant positive effect and the relative importance of different effects. Further work needs to be done to clarify these issues.

However, the relevant contextual information is only likely to become available through more detailed and sporadic investigations of similar interventions.

As for other types of non-financial returns, it is also important to record the level of financial support provided to the enterprise to allow for cost-effectiveness comparisons between enterprises.

Enterprises that have negative effects on women should also be monitored, with the negative impacts at the very least, qualitatively described.

3.2.12 Electricity Supply

The supply of a reliable source of electricity provides many important services such as lighting, cooking and refrigeration. The lack of these services is often considered a barrier to development. One enterprise in this study enabled the supply of electricity through the charging of batteries (3 to 10 customer/d). However, these batteries cannot usually be used for cooking or refrigeration and are usually used for lighting, or televisions.

If reliable electricity supply is a development objective, then the number of new recipients or households is a clear, comparable and relevant indicator. The number of new customers could not be quantified through this study, and is likely to require further study (not considered prohibitively more) on the community in question.

However, the final use of the electricity was raised as important through the analysis. Electricity supply does not guarantee benefits to the population, and monitoring of the final benefits (e.g., reduced cooking times leading to more productive uses of time, lighting to increase productive hours etc.) should ideally be monitored. Some further analysis of this issue would be required on a case-by-case basis before an ongoing indicator could be selected. In any case, qualitative information would need to be recorded to outline these issues.

Another issue raised in this study is the environmental aspects of using batteries as a source of electricity (e.g., inappropriate disposal) or health impacts such as acid spillage. These could potentially pose a future environmental hazard if not disposed of correctly. Concerns such as these should be recorded together with any quantitative measure.

Also, the amount of financial support is useful to record as it provides a basis for calculating the non-financial return on investment (e.g., number of new electricity connections/USD invested). However, care should be taken when using such a measure as the importance of the financial basis (e.g., through standard of living, purchasing power etc.) is also sure to vary between contexts.

3.2.13 Health Benefits of Reliable Water Supply

Populations without access to a reliable, regular supply of water tend to have higher incidences of disease than those with better access and are often required to spend significant time/labour collecting water. Also, a reliable water supply leads to improved agriculture (i.e., increases in food security) and subsequent nutritional benefits for livestock and humans.

One enterprise assessed in this study was responsible for the maintenance of wind powered water pumps. The ongoing maintenance of these pumps ensured a reliable water supply for the community. No quantitative data regarding improvements in health were available.

The assessment of health benefits and food security would require a survey of the changes in the affected communities' water related health, which is beyond the scope of this study. However, it was possible to provide an estimate of the number of people being serviced with a regular water supply. Such an estimate is useful if comparing with other water supply programmes and is simple and clear.

Information regarding the importance of water supply in a particular context would also be useful. The amount of financial support can also provide a useful basis for cost-effectiveness calculations.

Of course, interventions that contaminate the water supply should also be monitored although it is not yet clear which types of impacts should be under the jurisdiction of traditional regulatory requirements and which should be the focus of enterprise based assessment of non-financial returns. Further work needs to be done in this regard.

3.2.14 Infrastructure Improvement

One enterprise assessed during this study lead to the improvement of roads in the region of the project (a hydro power station). This infrastructure allows the community better access to important services (e.g., health, education) in nearby areas.

An assessment in the changes in benefits was beyond the scope of this study, and improvement in infrastructure is difficult to measure in any way except through the outcomes that it provides.

It is unlikely that the contribution of individual enterprises to infrastructure improvements can be measured although further investigation on this issue may be warranted. Qualitative information regarding the occurrence of these benefits should in any case be recorded. Information regarding which communities are positively affected could also be recorded for potential future reference together with the amount of financial support provided.

4. Discussion

This study considered the non-financial returns of a variety of business types operating in different contexts. However, from this analysis, a number of generalisations that merit further discussion can be made and are discussed in Section 4.1. Section 4.2 outlines some avenues for future research that have come to light as part of this study. This section aims to provide a discussion of important issues for consideration during the development of an ongoing monitoring programme for REED-type interventions.

4.1 Important Findings from Case Study Analysis

4.1.1 The Categorisation of an Impact

The impact categories used in this assessment where identified by interviewees and then categorised to facilitate manageable presentation of results. However, it is apparent that some discussion is required regarding how these impacts should be categorised.

Figure 4-1 illustrates the potential relationships between impacts for the enterprise KBPS (charcoal production from wood waste). Note that Figure 4-1 is not intended to represent the entire set of interactions of non-financial impacts, but is used to illustrate the types of interactions that can occur. KBPS was considered to have non-financial returns in terms avoided deforestation, job creation, waste utilisation and avoided environmental impacts of charcoal production. However, deforestation is an issue which itself comprises of several other impacts such as time/labour for communities that have to travel further to collect firewood. Deforestation can also lead to deterioration in soil quality due to nutrient loss or increases in salinity. Biodiversity loss may also be a related impact or, the preservation of the natural resource itself could be the result of a mostly philosophical policy position.

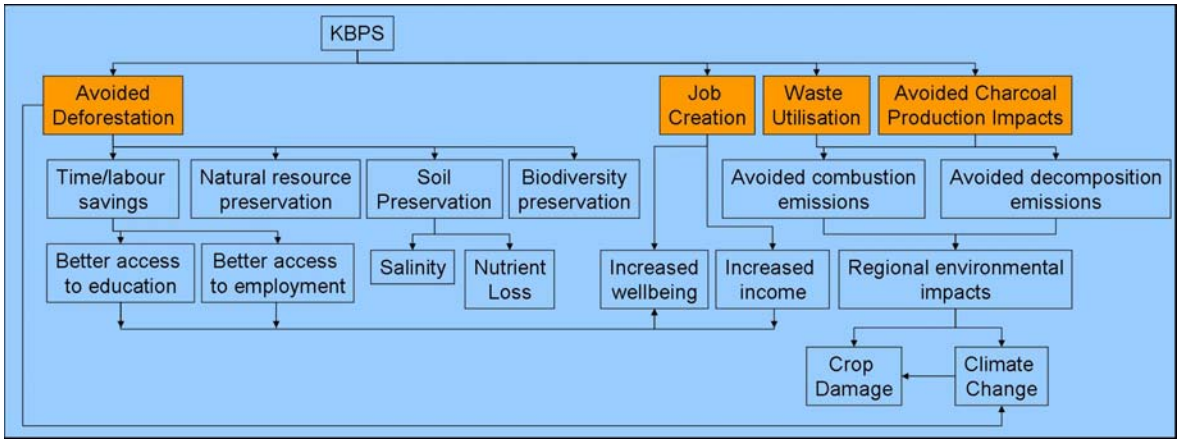

Figure 4-1: An Example of the Potential Relationships between Non-Financial Impacts of REED Enterprises

If one type of non-financial return, say deforestation is the predominant contributor to a particular outcome (e.g., loss of biodiversity), then an indicator of deforestation can be used as an indicator for biodiversity loss.

However, the issue of categorisation becomes problematic when different types of impact lead to the same outcome. For example, deforestation can lead to releases of greenhouse gases (leading to climate change impacts) together with the avoided combustion impacts due

to more efficient charcoal production or waste utilisation. Also, the time/labour savings due to the preservation of forest could be much more significant than job creation through the enterprise's supply chain. If job creation is an important outcome of a development intervention, then the contribution from both avoided deforestation and direct/indirect job creation should be monitored. However, it is difficult to estimate the job savings related to the preservation of forest, so this contribution may not even be assessable. Similarly although the greenhouse gas contributions from particular enterprises can be estimated, it does require significantly more effort to do so.

Redundancy is also an important issue. Counting impacts more than once can lead to over-emphasis on particular issues and a poor basis for decision-making.

It is clearly a difficult process to determine which aspects should be monitored. However, from the context of development interventions, each intervention should certainly be aimed at a particular set of outcomes. The contribution of the particular programme or enterprises to these outcomes should then be the subject of monitoring.

In theory, it is desirable to be able to compare the outcomes of different programmes and the relative performance of different enterprises in non-financial aspects. For example, the amount of deforestation (in ha) avoided due to a particular enterprise, although providing no information regarding the outcomes of this deforestation, can be used to compare enterprises that are operating in the same, or similar, context. This issue reinforces the need for a good understanding of context, otherwise comparability is not possible.

However, the practicality of monitoring requirements and data availability mean that it may not be possible to achieve a complete picture of how an enterprise, a group of enterprises or development programme is performing in terms of particular aspects. The starting point should be the development objectives of the programme itself, which should be based on a good understanding of the needs of the affected communities with compromises being made as required. Deficiencies in data should be explained as well as possible to allow them to be considered as part of decision-making processes.

Some aspects may also be best monitored through other programmes (e.g., looking solely at outcomes such as trends in health). This decision should, in theory, be made depending on the likely significance of enterprises contribution to a particular aspect. For example, although, soil quality may be affected through deforestation, the contribution of charcoal production to deforestation may not be considered significant enough to require monitoring. However, practical constraints are also likely to affect these decisions and should be recognised.

4.1.2 Both Qualitative and Quantitative Information is Necessary

A well selected indicator can provide a good basis for assessment of non-financial returns. However, in almost all the cases assessed in this study, the context of the enterprise was important and further qualitative information was critical for appropriate decision-making.

Context generally related to the specific needs of the communities affected by the enterprises, or the importance of a particular impact for the affected communities. One example was the case of charcoal cooking in Zambia, where it was not clear that a reduction in charcoal consumption would lead to significant health benefits. Another example is the case of deforestation in Zambia, which may not be as important as deforestation in, say, Tanzania. Therefore, the benefits of reforestation or avoided deforestation could not be

numerically compared and a subjective assessment would be necessary. Further, a given enterprise is likely to have a number of different impacts (that change over time) and when comparing a number of different enterprises in different contexts, the level of subjectivity in the assessment increases further.

Ideally, it is desirable to have good knowledge of the developmental needs of a community before assessment of an enterprise begins, although it is recognised that this is not always possible.

In some cases, the necessary qualitative information could only be obtained through methods more detailed than used here, although in many cases, the necessary contextual information was obtained as part of the data gathering process. It was also important to acknowledge the absence of important contextual information as this improved potential decision-making processes.

Information regarding the financial assistance provided is also likely to be useful. The cost-effectiveness of interventions may be an important issue (i.e.., amount of return per dollar invested) although context is also important when making these estimations. Factors such as cost of living and purchasing power of the community of interest affect the importance of a certain amount of money, which needs to be considered when making decisions.

4.1.3 Choice of Indicators is Strongly Limited by Data Availability

In many cases, very little or no information was available that could be used as a basis for ongoing assessment of non-financial impacts. In some cases, much more detailed assessment was required, likely to be beyond the resources of most enterprises or monitoring programmes. An example is the empowerment of women, which could only be assessed in terms of the number of women of positively affected. This is an oversimplification of a very complex issue. Labour/time savings could also be classified this way, as time saved, if available is unlikely to properly express the potential benefits to families that use this time in more productive ways. The question then became whether it was of value to make an assessment at all using less than ideal indicators.

This study took the general approach that if it was possible to assess the non-financial aspects in some way, even if not using an ideal indicator, then this was done. In general, some basis for decision-making is considered better than no basis at all. However, it is important to record any information that outlines the deficiencies in the approach so that decisions can be made with these deficiencies in mind. Also, as time goes by, these decisions could be rectified with improvements in data availability or further research.

It is also important to note that the methods used here for collecting data (telephone and email correspondence) were not suitable in all cases. The measurement of some outcomes are likely require either face-to-face meetings with people with good knowledge of the enterprise or much more labour intensive methods than used in this study (e.g., community surveys of health impacts). The methodological requirements for different non-financial impacts are outlined in Section 3.2.

4.1.4 Indicators cannot Always be Selected

In some cases (e.g., health impacts of cooking) it was simply not possible to select a suitable indicator. More work was needed before the non-financial returns of a particular enterprise could be estimated. Again, it is important to accept this deficiency and record this

information so that other research or monitoring efforts can attempt to address this deficiency.

Also, it simply may not be possible to assess non-financial impacts in a quantitative way (e.g., infrastructure improvement) at all. In this case, qualitative information can still provide a basis for decision-making.

More appropriate methods of assessing these impacts may lie outside the scope of an enterprise based monitoring programme, through for example, monitoring of national policy objectives or within other enterprise management or regulatory processes. Defining the scope of a development monitoring programme is therefore an important stage in the monitoring process.

4.1.5 Indicator Selection Criteria

The criteria of relevance, accuracy, neutrality, comparability and clarity were used as a reference for the evaluation of indicators. As discussed in Section 4.1.1, the relevance and redundancy (which affects neutrality) of particular impact categories was found to be particularly important, as the selection of indicators was often significantly influenced by data availability. Accuracy is a manageable issue provided uncertainty in estimates is recognised and described where possible. Clarity did also not seem to provide significant problems, although further feedback from stakeholders in the reporting process would be instructive.

Therefore, in the absence of other criteria, those used in this study are reasonable. Relevance and redundancy should be important criteria in the development of a programme-specific set of criteria.

Although not specifically related to indicator selection but more to the reporting process, transparency is also an important issue. Recognising the uncertainties and barriers is an important part of the decision-making process and a critical factor in the improvement of the process of enterprise/programme selection and monitoring.

4.1.6 Monitoring should be an Ongoing and Flexible Process

An ongoing and flexible process is necessary to be able to assess initial programme deficiencies and adapt to changes in understanding availability of new information. This study provides a picture of what an ongoing assessment programme may look like. Such a programme is, at least initially, likely to be limited by data availability although a relatively simplistic basis for comparison is possible. However, a simple, clear basis for decision-making is considered useful provided deficiencies in data are recognised and recorded.

It is therefore important to record information regarding context or deficiencies in current assessment so that during the ongoing review of the programme, these issues can potentially be addressed.

Also, an assessment programme should be able to adapt as development objectives and the practical understanding of sustainable development change.

4.1.7 The Value of a Framework of Sustainable Development

Non-financial returns are indicators of progress towards sustainable development. Therefore, some understanding of concept of sustainable development is necessary. A specific definition, guiding principles or framework of sustainable development was not developed for this study. It was assumed that those involved with the enterprises had a

reasonable understanding of the non-financial impacts of importance, in the context of sustainable development.

The study could have perhaps benefited from specific guidance regarding the characteristics of sustainable development. Such a framework would provide a consistent approach for the development of non-financial objectives that would be a good basis for comparison between enterprises.

However, the development of such guidance is a difficult undertaking, as evidenced by the many interpretations of sustainable development listed in this report. The best reasonable outcome, at this stage, is that those involved in the ongoing monitoring of non-financial aspects have a good understanding of the non-financial context in which the enterprise operates (i.e., an understanding of the likely non-financial impacts of the enterprise throughout the system) together with a good understanding of the likely non-financial aspects of the business itself. Although not specifically recommended (as it was not tested in this study), it is noted that a framework such as the sustainable livelihoods framework may be useful in providing a basis for understanding of the context in which the enterprise operates.

4.1.8 Objectives of Development

The development objectives of the communities affected by the enterprises were not specifically assessed as part of this study apart from some general observations regarding the relevance of non-financial impacts based on official country development objectives. A better understanding of development needs of the community will be required if ongoing assessment is to take place. Models of development such as the sustainable livelihoods framework can help in gaining this understanding.

The development programme itself (e.g., REED) also has its own particular objectives that should be based on the development needs of the communities in question. These objectives should also be the subject of ongoing monitoring to determine whether the objectives are being met, the reasons why/why not and to determine any necessary modifications to the programme.

Therefore, information regarding the contributions of particular enterprises must also be supplemented with monitoring related to the sustainable development needs of the community. Such assessment is likely to be resource intensive and can probably not be undertaken as part of only one programme. It is likely that a complementary approach is necessary where, for example, governments, as capacity develops, take responsibility for community level assessments and enterprises or organisations representing them, take responsibility for following the progress of the enterprise specific impacts. These comments are speculative and more work is necessary to determine the appropriate boundaries for monitoring efforts for specific programmes.

There may be reasons for providing development support that are not immediately reflected in the measurement of non-financial returns. For example, enterprises may be performed as demonstrations to show that a particular enterprise can be successful in a particular context, to improve confidence in the investment community. Such projects may often rate poorly in terms of cost-effectiveness calculations, and their real benefits may be very difficult to acknowledge in a quantitative way. However, as long as these reasons are acknowledged and recorded, then they can be considered together with any assessment of non-financial returns in a decision-making process.

4.1.9 Progress Towards Sustainable Development

Progress towards sustainable development is defined by the development needs of a particular community and a practical understanding of sustainable development. This study did not thoroughly assess the context specific aspects of these two factors.

Enterprises can be compared assuming that these factors are equivalent, an assumption that is unlikely to be true in many cases. Again, this outlines the importance of context specific factors during the monitoring programme.

Also since sustainability is more of a goal than a state of being, it is not possible to make a statement regarding the progress towards sustainable development of the enterprises assessed as part of this study. The enterprises that were studied did make positive non-financial contributions to their local community, although the significance and extent of these impacts in most cases require further supporting information.

However, the information found as part of this study can be used as a good basis for assessment of progress towards sustainable development as further contextual information becomes available.

4.1.10 Implications for Policy

This study has shown that a variety of potentially significant non-financial returns are associated with REED-type projects, few of which are presently associated with the value of the enterprises. The identification, description and quantification of these returns provides a basis for the incorporation of non-financial returns of energy-related enterprise development projects into the value of the enterprise itself (see Section 1.1.3). However, the selection and ongoing monitoring of these returns requires some development before it provides a solid basis for decision-making.

4.2 Directions for Future Research

Some further research is required before an appropriate monitoring programme can be implemented.

Contextual information regarding the development needs of the communities affected by the enterprises in question is important to enable good decision-making. This contextual information, where available, should be documented. Where not available, further study will be required to gain a good understanding of context specific development needs. The objective of this further research should be to provide objectives against which the contribution of specific enterprises can be measured.

As a picture of sustainable development objectives becomes more complete, this information can be incorporated into a more formalised (e.g., with allocated responsibilities, timelines etc.) monitoring programme, based on the general guidance provided in Section 5 below.

Also, it has become apparent that some non-financial aspects may be better monitored from approaches other to that used here. Some aspects may be better addressed under official regulatory processes (e.g., environmental regulations), internal company management, monitoring of national policy measures. Further work is needed to define the appropriate scope for an enterprise-based monitoring effort.

It may also be important to note that the development of a monitoring programme for non-financial returns for enterprises operating in developing countries can provide benefits in terms of capacity building in the management of non-financial aspects. More work will be required to determine how this capacity building could be best facilitated.

This study was also limited to specific methods of data collection and did therefore not review the available methods. Such a review is likely to be instructive for the development of any monitoring programme and is recommended before such a programme is developed.

5. Guidance for Practitioners – Selection and Assessment of REED-Type Enterprises

This section describes a process for the selection of enterprises for development support (Section 5.1) and their ongoing assessment (Section 5.2) that can be used by practitioners engaged in REED-type development assistance projects. The guidance is based on a process that was developed as a result of the literature review of the management, by enterprises, of non-financial aspects (Section 2) and also takes into account the results of (Section 3) and the methodological issues arising from (Section 4) this study.

The process described is intended to provide the basis for the development of a more formal assessment program for non-financial impacts, and is not intended as a fully developed model. Also, the design of the development project or programme, although influential in the enterprise selection process, is beyond the scope of this study and is not specifically addressed in this section. Some of the information presented here may, however, be useful when designing or managing development projects that incorporate REED-type investments.

5.1 Guidance for Selection of Enterprises

The selection of enterprises for development support is intended to complement the financial decision-making process and is, therefore, a linear process, is illustrated in Figure 5-1. The selection process leads into the ongoing assessment process that is described in Section 5.2.

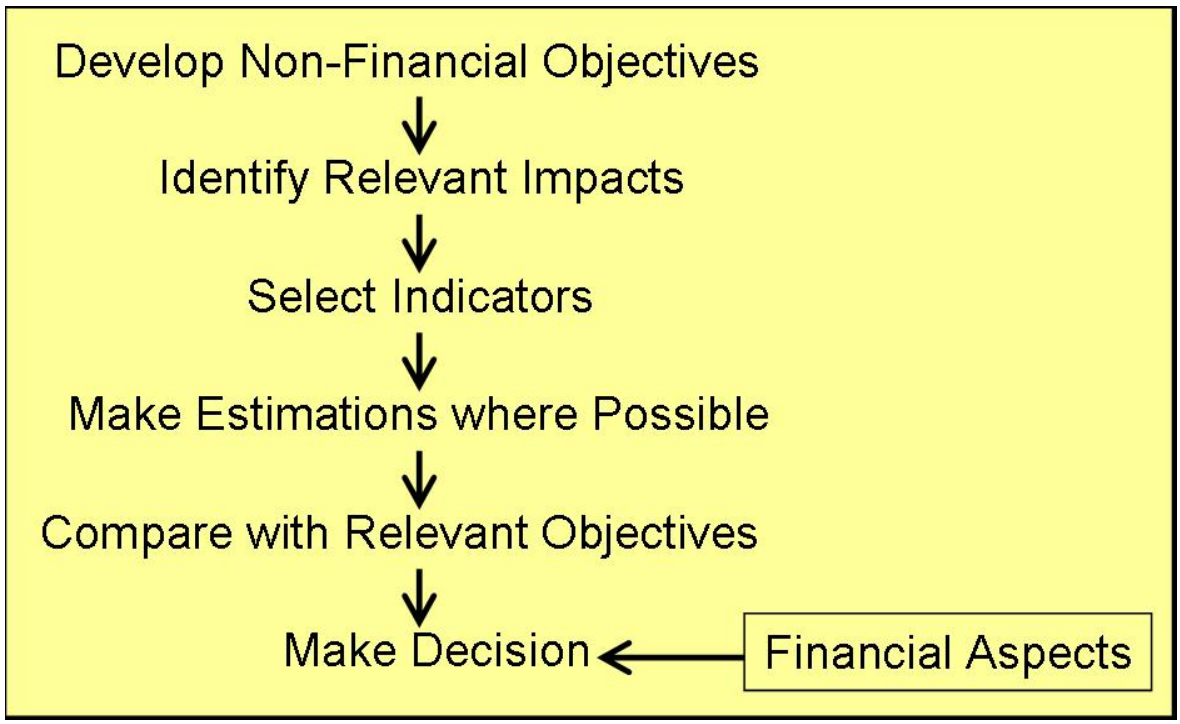

Figure 5-1: Guidance for the Selection of Enterprises

Develop specific non-financial objectives for the enterprises and the development programme
The development programme should have well-defined non-financial objectives. These objectives should reflect a good understanding of the specific system affected and are preferably based on a consistent framework of sustainable development. This study identifies some potentially relevant issues of development and sustainable development that can be used to develop a context-specific set of qualitative and, where relevant, quantitative criteria. The following objectives can be taken as examples of programme objectives:

- Deforestation: Enterprises within the programme should avoid deforestation or contribute to reforestation.

- Respiratory health: Enterprises supported within the programme should improve the respiratory health of the affected communities.

- Food security: The food security of the affected communities should be improved as a result of the support of the enterprises.

The criteria ultimately selected are likely to differ between countries or regions depending on the issues of importance. Also, a number of criteria are likely to be related to factors that are not easily measurable by the enterprises. For example, one objective could be that the programme should improve investor confidence. To aid in the review process and to ensure transparency, important issues that affect the selection of programme objectives and a justification for the selection for programme objectives should be recorded.

Each objective should be associated with an indicator that should be selected using a standard set of criteria (the criteria used in this study provide a good starting point) and limitations of data availability. Indicators that provide a reasonable basis for comparison should be selected. The likelihood of data availability to enable good comparison of enterprises should be specifically considered. Also, information regarding the limitations of selected indicators or important contextual factors should be recorded. The procedure for collection of information for each indicator should be defined at this stage.

Identify relevant impacts
The potential types of non-financial returns associated with each enterprise should be identified. The non-financial objectives of the programme should be used as a starting point. Additional types of returns may also be identified with a good knowledge of the enterprise and the potential associated impacts. In the absence of other information, data on non-financial returns of similar enterprises could be used. This study has recorded some of the returns associated with a number of different types of enterprises.

Select indicators
Based on a standard set of criteria (the criteria used and discussed in this study provide a starting point) and limitations of data availability, indicators that provide a reasonable basis for comparison should be selected for the enterprise. The likelihood of data availability for comparable enterprises should be specifically considered. For each indicator, a discussion regarding the justification for, and limitations of, selected indicators and that takes into account the criteria used for indicator selection and other important contextual factors, should be recorded.

The procedure for collection of information (e.g., allocation of responsibilities for data collection, types of information required, frequency of monitoring) for each indicator should be defined at this stage.

The boundary between which type of returns should be assessed as part of the monitoring programme and which impacts should be assessed by other means should be clearly established at this stage.

Make estimations where possible
If possible, estimations of the potential non-financial returns should be made. These estimations should be made based on knowledge of the specific enterprise or, in the absence of other information, knowledge of similar enterprises. If quantitative estimation is not possible, a qualitative judgement should be made. Areas of significant uncertainty associated with each return should be identified and described.

Important issues of context and/or limitations in the predictions should be recorded for assessment during the review of the monitoring programme.

Compare with development objectives
A comparison of potential returns with development objectives should be made to determine to what extent development objectives are being met. Also, benchmarking with other enterprises with the same types of non-financial returns should be made to help decision-making (see below).

Make decision
A decision should be made taking into account the non-financial objectives of the programme, the potential non-financial returns of the enterprise, any important factors relating to data reliability and the importance of impacts in a particular context. Any important factors affecting the decision should be recorded.

The final selection decision should of course be made taking into account the usual financial criteria. Financial viability is still an important prerequisite for any enterprise and should remain so. However, preference should be given to those enterprises that, through the process above, are determined to show the most progress towards the non-financial objectives of the development programme.

More specific guidance in the way in which non-financial and financial aspects should be integrated is beyond the scope of this study.

5.2 Guidance for Assessment of Enterprises

The assessment of enterprises should be an ongoing and flexible process. Such a process is necessary to be able to adapt to changing sustainable development objectives and improvements in issues affecting data reliability. Based on the findings of this study and taking into accounts its limitations, the cyclical process illustrated in Figure 5-2 is recommended. Due to the similarity in this process to the guidance for the selection of enterprises (see Section 5.1), the development of specific non-financial objectives for the development programme, the identification of relevant impacts and the selection of indicators are not elaborated further here. The estimation of returns, the review of the programme and the implementation of necessary modifications are described below.

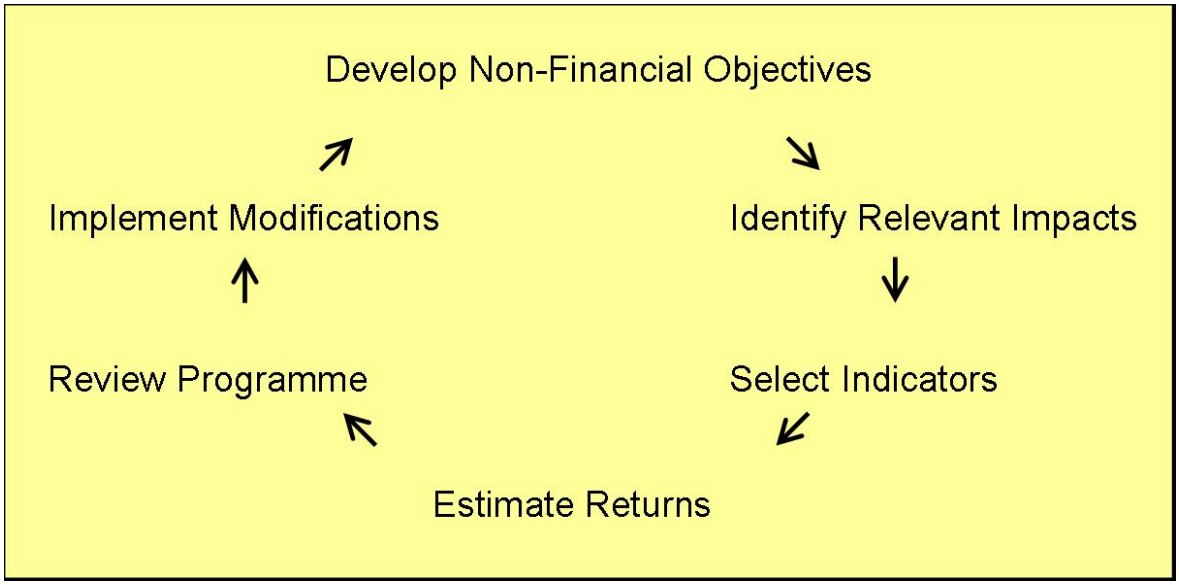

Figure 5-2: Process for Assessment of Enterprises

Estimate Returns
Estimations of the potential non-financial returns should be made using knowledge of the specific enterprise or, in the absence of other information, knowledge of similar enterprises. If quantitative estimation is not possible, a qualitative judgement should be made. Areas of significant uncertainty associated with each return should be identified and described.

Important issues of context and/or limitations in the predictions should be recorded during this stage for assessment during the review of the monitoring programme.

Review programme
This review should be performed on a regular basis and should determine, using the important issues identified throughout the process, whether programme objectives are being adequately met and/or whether the programme objectives are appropriate.

Implement necessary modifications
As development objectives change or monitoring limitations are addressed, appropriate modifications identified during the review should be implemented.

6. Conclusions

As a result of the recognition of the link between energy and sustainable development as well as the barriers to the development of private enterprises delivering important energy-related services, the REED-model of development is a type of development intervention that addresses these barriers.

Within a REED-type development intervention, aspects directly affecting the ongoing financial viability of the enterprise are closely monitored. However, the non-financial returns of these interventions, which can be of significance in terms of development objectives and can add value to both the enterprises and society, are not currently recognised.

A review of the concepts of development and sustainable development shows that they are in many aspects overlapping, perhaps converging, and require an understanding of, among other things, the multidisciplinary concepts of wellbeing, freedom, natural resource use and poverty. A review of these concepts provided a pool of issues that can be used as a resource in developing relevant objectives and targets, and identifying impacts.

In practice, the incorporation of non-financial aspects into the ongoing decision-making processes of enterprises can be simplified into a general process of setting objectives and targets, monitoring progress with quantitative and/or qualitative indicators, and regular review of the process. Such a process was therefore used in this study to determine the non-financial returns from 14 enterprises that were supported using the REED model of development.

In an attempt to estimate the non-financial returns of these enterprises, 14 different categories of returns were described and quantified. A variety of significant returns were documented for many of the enterprises and an assessment of relative progress was possible in many cases. This study can be used as a good basis for the assessment of progress towards sustainable development until further contextual information becomes available.

After an appraisal of the enterprises' non-financial returns, it became apparent that the following issues are likely to be important when developing a monitoring programme for non-financial returns:

- Both qualitative and quantitative information is necessary as an appropriate basis for decision-making, as the context (e.g., community needs and behaviour) within which an enterprise operates largely defines the importance of particular non-financial returns.

- Some further work is required in developing appropriate categories of impacts within a monitoring programme. Desired development outcomes of the programme should provide the basis for categorisation and should set the objectives by which an enterprise can be measured. This may imply further work in gaining this understanding of the communities affected by REED-type interventions.

- The choice of indicators for the measurement of non-financial returns is strongly limited by data availability. In fact, indicators cannot always be selected. Limitations should be accepted and recorded so that they can be addressed during the review process. Some basis for decision-making is better than no basis at all.

- The monitoring of non-financial returns should be an ongoing and flexible process. This study provides a useful starting point for the development of an ongoing monitoring programme. Relevance, redundancy and transparency should be important aspects in the development of indicator selection criteria for each individual programme.

- Some aspects may be better considered under internal company management procedures, existing regulatory frameworks or the monitoring of broader policy objectives. Monitoring within an enterprise-based programme cannot be holistic, and clear boundaries must be set to define which non-financial impacts can be assessed. Further work should involve developing useful local capacity in the management of non-financial aspects within private enterprises.

Taking into account the results of applying this simplified assessment methodology to a number of cases, guidance for the further assessment of enterprises was developed. This guidance is based on a simplified process developed as a result of a literature review and applies to most processes attempting to incorporate the ongoing assessment of non-financial aspects. The process can provide the basis for a more formal monitoring procedure and perhaps the integration of non-financial aspects into financial decision-making. This study provides a useful starting point for such a process. A further review of data collection methods is likely to be instructive.

The identification, description and quantification of such returns provides a basis for the incorporation of these into the value of the enterprise itself. However, the selection and ongoing monitoring of these returns requires some development before it can provide a solid basis for decision-making.

6.1 Personal Reflections

This study has provided some further evidence regarding the non-financial returns of small energy related enterprises. However, the approach used here has many academic weaknesses and a number of important questions remain unanswered.

It may have been ignorance or arrogance to simplify the entire body of literature regarding the management of non-financial aspects in enterprises to about one page of text. However, this simplification was not an attempt to belittle the efforts of thousands of management experts, but an outcome of the constraints facing much development work. The enterprises in question have much less resources than small to medium enterprises in developed countries, where even there, they are recognised to have significant constraints of time and/or resources. Simplicity in approach is an absolute necessity.

The philosophical premise used in this study is that faced with no system at all of ongoing assessment, any functioning system, even a very simple, highly uncertain and subjective one is better than no system at all and much better than an academically defensible one that is too complicated, costly or impractical to implement or operate.

Similarly, in an attempt to summarise relevant literature regarding sustainable development and development, many important sources are likely to have been omitted. Not much can be said to defend these omissions, and the complexity of the two issues is reinforced.

This study has shown that when non-financial aspects are considered, the analysis becomes more qualitative and subjective. Decisions regarding sustainable development may never be

simple but any step forward, recognising the uncertainties and barriers involved is considered as progress. The guidance provided here feels like a small step in the right direction.

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Abbreviations

AREED	African Rural Energy Enterprise Development
BREED	Brazil Rural Energy Enterprise Development
BS	British Standards
CERES	Coalition for Environmentally Responsible Economies
CH4	Methane
CO	Carbon Monoxide
CO2	Carbon Dioxide
CREED	China Rural Energy Enterprise Development
CSD	Commission on Sustainable Development
d	Day
EMA	Environmental Management Accounting
EMAS	Eco-Management and Audit Scheme
EMS	Environmental Management System
g	Gram
GDP	Gross Domestic Product
GRI	Global Reporting Initiative
GWh	Gigawatt Hours
h	hour
Ha	Hectare
ICLEI	International Council for Local Environmental Initiatives
IAEA	International Atomic Energy Agency
IEA	International Energy Agency
IIIEE	International Institute for Industrial Environmental Economics
ISO	International Organization for Standardization
kg	Kilogram
km	Kilometre
kWh	Kilowatt Hours
LPG	Liquefied Petroleum Gas
min.	Minute
MWh	Megawatt Hours
NGO	Non-Governmental Organisation
NMHC	Non-Methane Hydrocarbon
NOx	Oxides of Nitrogen
OECD	Organisation for Economic Co-operation and Development
p.a.	Per Annum
REED	Rural Energy Enterprise Development

t	Tonne
TSP	Total Suspended Particulate
TWh	Terawatt Hours
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNF	United Nations Foundation
UNIDO	United Nations Industrial Development Organization
USD	United States Dollars
y	Year
W	Watt

Appendix A – Case Study Summaries

Enterprise – KBPS

KBPS is a Zambian company receiving enterprise development support and financing to produce charcoal briquettes from sawmill waste. The company's expansion plan includes the construction of fifteen efficient brick kilns and the development of a marketing and distribution network.

Financial Assistance

USD 75 300 loan, 5 y payback at 12.0% p.a.

Non-Financial Returns

Avoided deforestation or reforestation
Using wood waste to produce charcoal displaces charcoal that would otherwise be produced using traditional techniques. Some deforestation, which leads to environmental impacts such as loss of biodiversity, erosion and salinity, is therefore avoided. Deforestation can also lead cause local impacts on nearby communities that use the forest as a source of fuel or food. In Zambia, deforestation is estimated at 851 000 ha/y (FAO, 2003) and as far as environmental issues are concerned, is considered by the national Ministry of Environment and Natural Resources as an area of national priority (MENR, 2003). However, this deforestation is mostly due to agriculture, rather than charcoal production (Serenje, Chidumayo, Chpuwa, Egnéus, & Ellegård, 1994) with approximately 8% of deforestation due to traditional charcoal production (Hibajene & Kalumiana, 1994).

The method of charcoal production used by KBPS is estimated to produce twice as much charcoal per mass of wood used than traditional methods. Therefore, KBPS's expected annual production of charcoal of 1200 t (i.e., 2400 t of traditional charcoal displaced) leads to an estimated avoided deforestation of approximately 220 ha/y[9] or about 0.026% of national deforestation.

Job creation
Employment creation is a central goal of Zambia's official poverty reduction strategy (ROZ, 2002).

KBPS employs a production manager, supervisor, two drivers and conductor and another 24 men and women within the community in the distribution network. More employees will be needed if demand for the product increases. However, the more efficient production process is less labour intensive than the traditional process and indirect job losses may occur if KBPS's product is displacing traditionally derived product in the market place.

Assuming a linear relationship between charcoal production and employment losses can be made (about 1 fulltime job for each 18 t of charcoal produced)[10]. KBPS is estimated to displace about 2400 t/y of traditionally produced charcoal accumulating yearly. This may equate to about 140 jobs displaced. Note that this is an exploratory calculation only and requires a better understanding of the traditional charcoal industry before being used for decision-making.

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[9] Assuming that 0.17 kg charcoal is produced per kg of wood consumed in the traditional process (Hibajene & Kalumiana, 1994) and that the average density of forest used for charcoal production in Zambia is 65 t/ha (Hibajene & Kalumiana, 1994).

[10] In 1995, Zambian charcoal production was estimated at 721 000 t and associated with 41 000 full time jobs (Hibajene & Kalumiana, 1994).

Waste utilisation

Waste logs (approximately 3500 t/y) that would otherwise be used as firewood (leading to emissions of products of combustion) or left to rot (leading to emissions of products of decomposition) are being used in the production process. Wood waste utilisation is not mentioned as a significant issue in Zambia's official poverty reduction strategy (ROZ, 2002) or Zambia's *National Environmental Action Plan* (MENR, 2003).

Avoided environmental impacts of traditional charcoal production

Traditional charcoal production leads to environmental impacts such as combustion emissions to air (from wood burning and vehicle emissions), changes in forest mineral composition and road damage to forested areas (Hibajene & Kalumiana, 1994). However, these impacts are often not considered significant (Hibajene & Kalumiana, 1994). KBPS's process of charcoal production avoids the impacts associated with 2400 t of this production annually.

Enterprise – RASMA

RASMA is a Zambian company producing low-cost, efficiency-improved stoves. RASMA is using an equity investment and support from project partners to expand the market with five retail outlets throughout the country, as well as radio advertising, direct marketing and displays at local markets. Because efficient cookstoves are a proven technology, the focus of AREED support is on commercialisation of the product and market expansion.

Financial Assistance

USD 20 000 equity investment.

Non-Financial Returns

Avoided deforestation or reforestation
Some deforestation, which leads to environmental impacts such as loss of biodiversity, erosion and salinity, is avoided due to reduced demand for charcoal. Deforestation can also cause local impacts on nearby communities that use the forest as a source of fuel or food. In Zambia, deforestation is estimated at 851 000 ha/y (FAO, 2003) and as far as environmental issues are concerned is considered by the national Ministry of Environment and Natural Resources as an area of national priority (MENR, 2003). However, this is deforestation is considered mostly to be due to agriculture, rather than charcoal production (Serenje et al., 1994) with approximately 8% of deforestation due to traditional charcoal production (Hibajene & Kalumiana, 1994).

Assuming a 30% reduction in charcoal consumption in the households using the stoves (estimates of the project partners), and the sales target of 400 stoves per month, approximately 180 ha/y of deforestation are avoided due to RASMA's operations[11].

Job creation
RASMA comprises 5 full time employees. Additional employees will be added if the business grows. A widespread dissemination of these stoves could lead to indirect job losses in the traditional fuel chain if demand for charcoal is significantly reduced. Assuming a linear relationship between charcoal production and employment losses can be made (about 1 fulltime job for each 18 t of charcoal produced)[12]. Based on sales targets, RASMA reduces charcoal consumption by about 2000 t/y, accumulating yearly. This may equate to about 100 jobs lost. Note that this is an exploratory calculation only and the assumptions that form its basis require verification.

Note that employment creation is a central goal of Zambia's official poverty reduction strategy (ROZ, 2002).

Avoided health/environmental impacts of traditional fuel use
The use of charcoal for cooking in the home can lead to health impacts to residents, usually women and children. However, it has been found that due to differences in ventilation, housing structure, fuel type and cultural habits (e.g., cooking outside) the impacts due to cooking with charcoal in Zambia are not as great as in many other countries and a reduction in charcoal consumption may not lead to significant improved health effects (Ellegård & Egnéus, 1992).

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[11] Assuming that 0.17 kg charcoal is produced per kg of wood consumed in the traditional process (Hibajene & Kalumiana, 1994) and that the average density of forest used for charcoal production in Zambia is 65 t/ha (Hibajene & Kalumiana, 1994).

[12] In 1995, Zambian charcoal production was estimated at 721 000 t and associated with 41 000 full time jobs (Hibajene & Kalumiana, 1994).

The stoves manufactured and sold by RASMA are estimated by the local project partner to reduce charcoal consumption by 30%. No emission profile from these particular stoves is available. Assuming a linear reduction in emissions based on literature data (an assumption that should certainly be tested at a later date), and based on the enterprises target of sales of 400 stoves per month and an average charcoal consumption in Zambia of 3.8 kg per household/d (Karekezi, Kalumiana, & Mangwengwende, 2003), the potential reduction in emissions in Zambia are listed in Table A-1.

Table A-1: Estimated Potential Emission Reductions due to RASMA's Sales of Improved Stoves[13]

Pollutant	**Emission Factor** (g pollutant/kg charcoal)	**Traditionally Calculated Emissions** (t/y)	**Estimated Emissions Savings due to RASMA's Stoves** (t/y)
TSP	2.4	16	4.8
NO_X	0.22	1.5	0.44
CO	155	1000	310
CO_2	2436	16000	4900
CH_4	8.0	53	16
NMHC	6.5	43	13

Also, it should be noted that the emissions released during combustion could also be of national or international concern (e.g., greenhouse gases).

Traditional charcoal production leads to environmental impacts such as combustion emissions to air (from wood burning and vehicle emissions), changes in forest mineral composition and road damage to forested areas (Hibajene & Kalumiana, 1994). However, these impacts are often not considered significant (Hibajene & Kalumiana, 1994)). The use of more efficient stoves reduces these impacts.

Labour/time savings

Using improved cooking stoves results in less demand for charcoal. Lower demand leads to time savings (and associated labour savings) due to charcoal collection. Time savings are typically not in households that must collect firewood for cooking as charcoal is usually bought at the market place. No further data are currently available.

Increased personal/household income

Households in Zambia typically spend USD 0.34/d on charcoal use (Karekezi et al., 2003). This is approximately 8% of daily household income[14]. Assuming a saving of 30% as indicated earlier, approximately USD 0.10/d would be saved (once the stove has been paid for) in 4 800 households/y.

[13] The emission factors for TSP was taken from Ellegård & Egnéus (1992). Emission factors for other pollutants were taken from a compilation of emission factors for wood- and charcoal-fired stoves (Bhattacharya, Albina, & Abdul Salam, 2002).

[14] Based on household size and income data from the World Bank (WB, 2003b).

Enterprise – Ubwato

Ubwato core business is the manufacture and sale of improved charcoal stoves in Zambia. The company is using a loan of and management support to implement a marketing strategy involving a commissioned sales force that is intended to lead to full commercialisation of the product and further market expansion. A first disbursement of financial support has already been provided to purchase 20 bicycles and trailers, implement the support marketing activities and provide a small amount of working capital. A second disbursement of financial support will be used to upscale the production facilities, purchase a further 20 bicycles and trailers and implement further supportive marketing activities. The third and final disbursement – when sales figures reach the 800 units per month mark – will see the final procurement of the plant and machinery required as well as another 20 bicycles and trailers.

Financial Assistance

First disbursement (already paid) USD 15 855 loan, 4.5 y payback at 5.0% p.a.

Second disbursement (not yet paid) USD 15 000, terms not yet agreed.

Third disbursement (not yet paid) USD 10 000, terms not yet agreed.

Non-Financial Returns

Avoided deforestation or reforestation
Some deforestation, which leads to environmental impacts such as loss of biodiversity, erosion and salinity, is avoided due to reduced demand for charcoal. Deforestation can also cause local impacts on nearby communities that use the forest as a source of fuel or food. In Zambia, deforestation is estimated at 851 000 ha/y (FAO, 2003) and as far as environmental issues are concerned is considered by the national Ministry of Environment and Natural Resources as an area of national priority (MENR, 2003). However, this is deforestation is considered mostly to be due to agriculture, rather than charcoal production (Serenje et al., 1994) with approximately 8% of deforestation due to traditional charcoal production (Hibajene & Kalumiana, 1994).

Assuming a 30% reduction in the households using the stoves (an estimate provided by the project partners), and the sales target of 500 stoves per month, approximately 230 ha/y of deforestation are avoided due to Ubwato's operations[15].

Job creation
Employment creation is a central goal of Zambia's official poverty reduction strategy (ROZ, 2002). Ubwato comprises seven full time employees: the director, the production and marketing manager, the accountant and four artisans. Casual labour is employed as needed. Ambitious growth is forecast for the business and further employees will be added if this growth materialises.

A widespread dissemination of these stoves could lead to indirect job losses in the traditional fuel chain if demand for charcoal is significantly reduced. Assuming a linear relationship between charcoal production and employment losses can be made (about 1 fulltime job for each 18 t of charcoal produced)[16]. Based on sales targets, Ubwato reduces charcoal consumption by about 2500 t/y,

[15] Assuming that 0.17 kg charcoal is produced per kg of wood consumed in the traditional process (Hibajene & Kalumiana, 1994) and that the average density of forest used for charcoal production in Zambia is 65 t/ha (Hibajene & Kalumiana, 1994).

[16] In 1995, Zambian charcoal production was estimated at 721 000 t and associated with 41 000 full time jobs (Hibajene & Kalumiana, 1994).

accumulating yearly. This may equate to about 140 jobs lost. Note that this is an exploratory calculation only and the assumptions that form its basis require verification.

Avoided health/environmental impacts of traditional fuel use

The use of charcoal for cooking in the home can lead to health impacts to residents, usually women and children. However, it has been found that due to differences in ventilation, housing structure, fuel type and cultural habits (e.g., cooking outside) the impacts due to cooking with charcoal in Zambia are not as great as in many other countries and a reduction in charcoal consumption may not lead to significant improved health effects (Ellegård & Egnéus, 1992).

The stoves manufactured and sold by Ubwato are estimated by the local project partner to reduce charcoal consumption by 30%. No emission profile from these particular stoves is available. Assuming a linear reduction in emissions based on literature data (an assumption that should certainly be tested at a later date), and based on the enterprises target of sales of 500 stoves per month and an average charcoal consumption in Zambia of 3.8 kg per household/d (Karekezi et al., 2003), the potential reduction in emissions in Zambia are listed in Table A-2.

Table A-2: Estimated Potential Emission Reductions due to Ubwato's Sales of Improved Stoves[17]

Pollutant	**Emission Factor** (g pollutant/kg charcoal)	**Traditionally Calculated Emissions** (t/y)	**Estimated Emissions Savings due to Ubwato's Stoves** (t/y)
TSP	2.4	20	6.0
NOx	0.22	1.8	0.55
CO	155	1300	390
CO_2	2436	20000	6100
CH_4	8.0	67	20
NMHC	6.5	54	16

Also, it should be noted that the emissions released during combustion could be of national or international concern (e.g., greenhouse gases).

Also, traditional charcoal production leads to environmental impacts such as combustion emissions to air (from wood burning and vehicle emissions), changes in forest mineral composition and road damage to forested areas (Hibajene & Kalumiana, 1994). However, these impacts are often not considered significant (Hibajene & Kalumiana, 1994)). The use of more efficient stoves reduces these impacts.

Labour/time savings

Using improved cooking stoves results in less demand for charcoal. Lower demand leads to time savings (and associated labour savings) due to charcoal collection. Time savings are typically not as great as for households that must collect firewood for cooking as charcoal is usually bought at the market place. No further data are currently available.

[17] The emission factors for TSP were taken from Ellegård & Egnéus (1992). Emission factors for other pollutants were taken from a compilation of emission factors for wood- and charcoal-fired stoves (Bhattacharya et al., 2002).

Increased personal/household income

Households in Zambia typically spend USD 0.34/d on charcoal use (Karekezi et al., 2003). This is approximately 8% of daily household income[18]. Assuming a saving of 30% as indicated earlier, approximately USD 0.10/d would be saved (once the stove has been paid for) in 6000 households/y.

[18] Based on household size and income data from the World Bank (WB, 2003b).

Enterprise – TSADC

TSADC is a newly established Zambian company with the core activity of establishing financially viable bakeries, which utilise solar energy, to produce fresh wheat products in the form of bread and buns for sale to local communities. The short-term goals for TSADC include the development and testing of a financially viable business model for rural bakeries using the Villager Sun Oven, a proven form of solar cooking. In the long term, large-scale replication of these models to other rural sites in Zambia is envisioned.

Financial Assistance

USD 20 000 loan, 4 y payback at 5% p.a.

Non-Financial Returns

Avoided deforestation or reforestation
Some deforestation, which leads to environmental impacts such as loss of biodiversity, erosion and salinity, is avoided due to reduced demand for charcoal. Deforestation can also cause local impacts on nearby communities that use the forest as a source of fuel or food. In Zambia, deforestation is estimated at 851 000 ha/y (FAO, 2003) and as far as environmental issues are concerned is considered by the national Ministry of Environment and Natural Resources as an area of national priority (MENR, 2003). However, this is deforestation is considered mostly to be due to agriculture, rather than charcoal production (Serenje et al., 1994) with approximately 8% of deforestation due to traditional charcoal production (Hibajene & Kalumiana, 1994).

The use of one oven for bakery purposes has been estimated to avoid the use of 150 t of wood (SOI, 2003), which, using typical Zambian data[19], equates to approximately 14 ha/y of forest per oven.

Job creation
Employment creation is a central goal of Zambia's official poverty reduction strategy (ROZ, 2002). TSADC is a new business and has not yet begun operation. Little data is currently available regarding the job creation benefits of TSADC although if the business is proven successful, jobs are expected to be created throughout the distribution chain. A widespread dissemination of this technology could affect employment in the charcoal production chain.

Assuming a linear relationship between charcoal production and employment losses can be made (about 1 fulltime job for each 18 t of charcoal produced)[20]. The solar oven used by TSADC is estimated to avoid the use of 150 t/ of wood, which equates to approximately 26 t of charcoal. This equates to about 1 job lost. Note that this is an exploratory calculation only and the assumptions that form its basis require verification.

Avoided health/environmental impacts of traditional fuel use
The use of charcoal or wood fuel can lead to significant health or environmental impacts, although the impacts in commercial applications are not well documented. The oven is estimated to displace the use of approximately 150 t/y of wood, which, based on typical Zambian data, equates to approximately 26 t/y of charcoal.

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[19] Assuming that 0.17 kg charcoal is produced per kg of wood consumed in the traditional process (Hibajene & Kalumiana, 1994) and that the average density of forest used for charcoal production in Zambia is 65 t/ha (Hibajene & Kalumiana, 1994).

[20] In 1995, Zambian charcoal production was estimated at 721 000 t and associated with 41 000 full time jobs (Hibajene & Kalumiana, 1994).

Table A-3 shows an estimate of emission reduction savings depending on whether charcoal or wood fuel is used and Table A-4 shows the emissions avoided from the charcoal production process (assuming charcoal use is being displaced). The actual health or environmental impacts of these emissions are much more difficult to assess and are not estimated here.

Also, traditional charcoal production leads to environmental impacts such as combustion emissions to air (from wood burning and vehicle emissions), changes in forest mineral composition and road damage to forested areas (Hibajene & Kalumiana, 1994). However, these impacts are often not considered significant (Hibajene & Kalumiana, 1994)). The displacement of charcoal production reduces these impacts.

Table A-3: Estimated Potential Emission Reductions from Charcoal or Wood Combustion due to Solar Oven Use[21]

Pollutant	**Emission Factor Charcoal Cooking (g/kg charcoal)**	**Estimated Emissions Savings based on Charcoal Combustion (t/y)**	**Emission Factor Wood Combustion (g/kg wood)**	**Estimated Emissions Savings based on Wood Combustion (t/y)**
TSP	2.4	0.061	7.7	1.2
NO_X	0.22	0.0056	0.11	0.017
CO	155	4.0	26.85	4.0
CO_2	2436	62	1582.5	240
CH_4	8.0	0.20	10	1.5
NMHC	6.5	0.17	8.15	1.2

Table A-4: Estimated Potential Emission Savings from Charcoal Production due to Solar Oven Use[22]

Pollutant	**Emission Factor Charcoal Making**	**Units**	**Estimated Emissions Savings from Charcoal Making (t/y)**
TSP	2.3	g/kg of charcoal produced	0.057
NO_X	0.066	g/kg of dry wood consumed	0.0069
CO	70	g/kg of dry wood consumed	7.3
CO_2	440	g/kg of dry wood consumed	46
CH_4	11	g/kg of dry wood consumed	1.1
NMHC	3.0	g/kg of dry wood consumed	0.31

[21] TSP emission factor taken from Ellegård & Egnéus (1992). Emission factors for other pollutants were taken from a compilation of emission factors for wood- and charcoal-fired stoves (Bhattacharya et al., 2002).

[22] TSP emission factor taken from Smith et al, (1998). Other emission factors taken from Innes (2000) with a middle of the range Zambian wood moisture content taken from Hibajene & Kalumiana (1994).

Enterprise – CWV

CWV is a retailer of motor control equipment that received a loan to expand its business of sourcing, marketing, installing and interval maintenance of control gear for heavy-duty electric motors in Zambia. Initial marketing efforts are directed towards users around the Lusaka area, including firms engaged in manufacturing, commercial export farming, tourism, trading, mining, physical infrastructure, and water and energy supplies. Ultimately, the company anticipates expanding its market area to the other nine Zambian provinces as the organization grows. The primary selling point for the control gear is electricity costs savings.

Financial Assistance

A loan of USD 22 300, 2 y payback period at 12.0% p.a.

Non-Financial Returns

Job creation
Employment creation is a central goal of Zambia's official poverty reduction strategy (ROZ, 2002). The company consists of three permanent employees. Casual labour is employed depending on variations in sales volume. As the company grows, the addition of more employees is expected. The product leads to cost savings for customers. This could potentially lead to increased further employment although no data are currently available.

Electricity savings
The energy savings of the motor control equipment average about 10%. No further data are available. Electricity production in Zambia is hydropower dominated, with 99% of electricity generated in this way (Nationmaster.com, 2003). However, electricity accounts for only 14% of energy consumption, with wood-based fuels supplying the majority (70%) of energy needs (ROZ, 2002).

Zambia's energy related development policy is focussed on increasing access to electricity and creation of new infrastructure (ROZ, 2002).

Cost savings
The customers of CWV save money as a result of the installation of the control equipment. Unfortunately, no data regarding these savings are currently available.

In general terms, Zambia supports the growth of small to medium enterprises as part of its poverty reduction strategy (ROZ, 2002).

Enterprise - Biomass Energy Tanzania Ltd (BETL)

BETL will source, transport and supply biomass waste to meet the thermal heating needs of the Tanga Cement Company Limited (TCCL). The capital assistance supplied to BETL will enable the company to service the demands of the TCCL contract and establish itself as a key provider of biomass waste to industries in fuel switching applications. TCCL's intention is to exclusively purchase up to 1000 tons of biomass waste from BETL on a monthly basis. BETL intends to offer a similar service to other companies in the region through the establishment of a biomass cultivation network.

Financial Assistance

USD 50 000 loan, 4 y payback at 10% p.a.

Non-Financial Returns

Avoided deforestation or reforestation
As the business develops, and biomass crops are cultivated, significant areas are expected to be reforested. Note that the deforestation rate in Tanzania is approximately 91 000 ha/y or about -0.23% (FAO, 2003) and the government of Tanzania also sees reforestation as a way of addressing the issue of human vulnerability due to food insecurity as part of its national poverty reduction strategy (WB, 2000a) and as an important part of energy policy (URT, 2003).

Job creation
Initially, two administration positions will be created within the enterprise itself. Further, the financial assistance is being used to develop a biomass crop-base for the business to enable expansion. This will lead to up to 1000 (as estimated by the entrepreneur) indirect jobs in biomass cultivation and processing. The entrepreneur has indicated that he is encouraging potential suppliers to grow biomass crops that can yield several different revenue streams (cashew nuts, jatropha, moringa, castor etc.) and intercrops and boundary crops (e.g., honey, essential oils) to strengthen job security. At this stage it is assumed that the fossil fuel substitution is not leading to job losses in other sectors.

Tanzania's official poverty reduction strategy (WB, 2000a) comprises four main aspects:

1. Increasing economic growth;
2. Increasing market efficiency;
3. Promotion of export oriented expansion and diversification of the "pro-poor" sectors; and
4. Raising of investment in the cultivation of traditional and new crops, small and medium size enterprises, and informal sector activities.

This enterprise appears to be directly beneficial to aspects three and four above.

Fossil fuel substitution
Initially, 2500 MWh per month of heavy fuel oil based energy is being displaced through the use of biomass fuel. This should increase to approximately 5000 MWh per month in the short term (before December 2003).

Tanzania's energy policy aims broadly to (URT, 2003):

- Develop domestic energy resources which are shown to be least cost options;
- Promote economic energy pricing;
- Improve energy reliability and security and enhance energy efficiency;
- Encourage commercialisation and private sector participation;
- Reduce forest depletion; and
- Develop human resources.

Support of BETL seems consistent with a number of aspects of this policy, especially developing domestic resources, encouraging commercialisation and reducing forest depletion.

Enterprise – Bagani

Bagani was provided with a loan to build, own and operate two "Jatropha Platforms" in the Kita area of Mali. Powered on Jatropha oil, derived from Pourghere nuts, the platforms can peel and grind various cereals and grains, work typically done manually with a mortar and pestle, as well as charge batteries. When the Pourghere nuts are pressed, in addition to oil, they produce two viable by-products. The first is sediment used for making soap and the second is a "torteau" or cake that is sold to farmers for fertiliser. The platforms are also equipped with a press to enable the production of Jatropha oil that is used as fuel for the platform or can be sold as a diesel substitute.

Similar platforms have been established throughout Mali as part of a UNDP programme. The UNDP platforms, known as the "multifunction platforms", often have additional functions attached to them such as welding, electricity production and water pumping. The platforms established by Bagani, do not at this stage have these additional functions.

Financial Assistance

USD 15 170 loan, 5 y payback period at 10% p.a.

Non-Financial Returns

Job creation
The operation of the platform requires a number of operators. The mechanical power allows households to produce relatively large amounts of various products that can then be sold. Also, the electricity supplied by the platform can allow other entrepreneurs to establish enterprises.

It is estimated that roughly between 300 and 450 people (mostly women) are using the platforms on a regular basis to produce income generating products. This occurs mostly during the months from August to January when the raw materials (plants) are mostly available. No information is available for the activity during the other months of the year although it is known that some other products are also being made.

Job creation is an important part of Mali's official poverty reduction strategy and has specifically identified the promotion of entrepreneurial spirit and the use of appropriate technology to favour local manpower and resources (ROM, 2002).

Labour/time savings
The platforms are used to perform manual labour that would otherwise be performed by hand. Both time and physical effort are saved through the use of the platform. The time saved allows customers to spend time on other activities such as employment or education.

It is estimated by the local AREED project partner that between 50% and 70% of the households (between 30 and 110 households) in the village are using the platform. As no further data is available for these particular platforms, data from other platforms in Mali will be used for this assessment.

Time savings have been documented as follows (UNDP, 2001b):

- Rice husking: >98% (48 h to less than 1 h)
- Processing of shea nuts: 39% (8 h 15 min. to 4 h 30 min.). Note that this time saving does not incorporate the increased yield of usable product (29% increase in usable product), as the increased yield may not necessarily lead to time savings (if sold for profit).

Empowerment of women

The benefits to women of the Jatropha platform are diverse. In general however, most of the benefits lead from the time/labour saving benefits of the platform. Data from other platforms in Mali show that 99% of the customers are women. This has lead to indirect benefits such as improved levels of education in the villages (as saved time can be spent on education) and creation of direct (as operators of the platforms) and indirect (utilisation of saved time for income generating purposes) employment.

Another village in Mali reported 843 women customers/d and data from other villages indicates the direct employment of between four and 10 women operators.

Mali has recognised the importance of women in its official poverty reduction strategy and has the following specific aims that are consistent with the impacts of the Bagani platform (ROM, 2002):

- Promoting literacy and formal education amongst girls and women;
- Creating an institutional and social environment that assures and guarantees equality between men and women;
- Promoting and systematising gender approaches in the formulation and implementation of development projects and programmes;
- Consolidating revenue-generating activities and promotion of access to micro-finance;
- Developing the entrepreneurial spirits of women;
- Encouraging the use of alternative energy sources; and
- Wider use of appropriate equipment and technologies.

Electricity supply

Many households in the village are using the platform to recharge batteries that are used to provide household electricity for services such as lighting, televisions etc. It is estimated that between three and ten customers are using the battery charging service/d. Anecdotal evidence from the project partners suggests in Mali that more households may be purchasing batteries (i.e., increased access to electricity) although there is no evidence to quantify this at the moment.

The Government of Mali sees the need of increasing the share of the population served by energy and the production and distribution of low-cost electricity (ROM, 2002). However, the promotion of the use of potentially toxic batteries may not be appropriate in terms of human health goals or ecological sustainability.

Enterprise – USISS

USISS is a company that preserves meat, mangoes and onions in Mali using a solar drying technology developed through a former German Technology Cooperation (GTZ) development project. A loan and enterprise development support will enable USISS to scale-up its business through the purchase of additional solar dryers and the implementation of a marketing strategy.

Financial Assistance

USD 19 665 loan, 5 y payback at 12.0% p.a.

Non-Financial Returns

Job creation
USISS comprises six employees within the bakery itself and a number of further employees that sell the product at the marketplace. No significant indirect employment impacts are anticipated. No further data are available.

Job creation is an important part of Mali's official poverty reduction strategy and has specifically identified the promotion of entrepreneurial spirit and the use of appropriate technology to favour local manpower and resources (ROM, 2002).

Fossil fuel substitution
The use of solar powered drying technology displaces the use of traditional fuel that would otherwise be used to dry the products.

Mali's official poverty reduction strategy does identify the reduction in traditional fuel as an important aspect of energy-related development policy (ROM, 2002).

Enterprise – AB Management

AB Management (Ghana) is building a new business to address the poor power quality of many African electricity networks. Using a loan (advanced in 2001) and enterprise development support, AB Management is creating a market for "power factor" correction equipment (i.e., capacitors) in Ghana. The loan allows AB Management to purchase a significant amount of equipment and sell to customers on credit. Previously only up-front payments were possible. The first round of 27 installations was fully subscribed by mid-March 2002, while cash inflow from credit arrangements with customers began in April 2002.

Financial Assistance

USD 122 400 loan, 5.5 y payback at 12.0% p.a.

Non-Financial Returns

Job creation
No data is available regarding the direct employment of AB Management. The product leads to cost savings for customers. This could potentially lead to further increases employment although no data are currently available.

Job creation through "creating an enabling environment to stimulate private sector activities" is considered an important objective of Ghana's official poverty reduction strategy (WB, 2003a)

Electricity savings
The purpose of the equipment is to reduce electricity consumption. Information from the programme partners indicates average savings of approximately 20%. The project partners have estimated greenhouse gas savings of up to approximately 31 000 t/y of CO_2 equivalent, although the basis of this calculation is not currently available.

Fossil fuels account for 30% of electricity production in Ghana although traditional fuels account for 78.1% of total energy consumption (Nationmaster.com, 2003)

Cost savings
The customers of CWV save money as a result of the installation of the control equipment. However, no data regarding these savings are currently available.

Enterprise – Anasset

Anasset is a venture with the core business of selling LPG at a filling station. The business is located on a main arterial road in Accra, the capital of Ghana, and has plans to expand the business to rural areas. Financial assistance in the form of a loan was provided to assist in the growth of the company, by providing key equipment and an upgrade of the existing facility. This growth is then intended to provide the basis for an expansion into a second station. Anasset has short-term plans of expanding and distributing gas to rural areas.

Financial Assistance

USD 38 000 loan, 4 y payback at 7.5% p.a.

Non-Financial Returns

Avoided deforestation or reforestation
Using LPG displaces the need for wood fuel. Some deforestation, which leads to environmental impacts such as loss of biodiversity, erosion and salinity, is therefore avoided. Deforestation can also cause local impacts on nearby communities that use the forest as a source of fuel or food and lead to long collection times and distances for households reliant on wood fuel. In Ghana, deforestation is estimated at 120 000 ha/y or about 1.72% of available resources (FAO, 2003).

LPG sales, since AREED support was given, have been approximately 140 t per month or 1130 t in 8 months. Assuming constant sales for a year, 1 680 t/y of sales are expected. This amount of LPG typically equates to about 5 300 t of charcoal or 15 600 t of wood (UNDP, 2003) in Ghana. Anasset's customer base is in Accra, where 57% of households use charcoal and 9% of households use wood (UNDP, 2003). According to the project partners, it is likely that most customers of Anasset would have been using charcoal or wood before switching to LPG. Assuming that Anasset's customers used fuel in the same proportions as the literature data, approximately 4600 t/y of charcoal and 2100 t/y of wood are being displaced. Approximately 8 t of wood are required to produce 1 t of charcoal in Ghana (Stosch & Quaye, 2002). Therefore, 38 900 t/y of deforestation is being displaced. This is equivalent to approximately 810 ha/y of forest of avoided deforestation or 0.68% of annual deforestation.

It is assumed that all customers are households, although research is currently underway by the project partners to better define the customer base.

Job creation
Job creation through "creating an enabling environment to stimulate private sector activities" is considered an important objective of Ghana's official poverty reduction strategy (WB, 2003a).

Anasset comprises of a few employees. Company growth is expected to lead to the need for further employees. There is also a potential for indirect job losses due to the displacement of jobs in the traditional charcoal production process. Assuming a linear relationship between charcoal production and employment losses can be made (about 1 fulltime job for each 18 t of charcoal produced)[23]. As estimated above, 4600 t/y of charcoal are displaced. This may be equivalent to about 260 jobs displaced. Note that this is an exploratory calculation only and the assumptions that form its basis require verification.

[23] In 1995, Zambian charcoal production was estimated at 721 000 t and associated with 41 000 full time jobs (Hibajene & Kalumiana, 1994).

Avoided health/environmental effects of traditional fuel use

The use of wood fuel for cooking in the home can lead to health impacts to residents, usually women and children. Actual impacts are however due to factors such as ventilation, housing structure, fuel type and cultural habits (Ellegård & Egnéus, 1992). Switching to LPG can avoid many of these impacts.

Assuming that Anasset's customers used fuel in the same proportions as the literature data, approximately 4600 t/y of charcoal and 2100 t/y of wood are being displaced (see above).

Also, the emissions released during combustion can be of national or international concern (e.g., greenhouse gases). No data regarding the health/environmental outcomes related specifically to Anasset were available. However, some data regarding the avoided emissions were estimated and are listed in Table A-5, Table A-6 and Table A-7.

Table A-5: Estimated Potential Emission Reductions from Charcoal or Wood Combustion[24]

Pollutant	**Emission Factor Charcoal Cooking (g/kg charcoal)**	**Estimated Emissions Savings from Charcoal Combustion (t/y)**	**Emission Factor Wood Combustion (g/kg wood)**	**Estimated Emissions Savings from Wood Combustion (t/y)**
TSP	2.4	11	7.7	16
NO_X	0.22	1.0	0.11	0.23
CO	155	710	26.85	56
CO_2	2436	11000	1582.5	3300
CH_4	8.0	37	10	21
NMHC	6.5	30	8.15	17

Table A-6: Estimated Potential Emission Savings from Charcoal Production[25]

Pollutant	**Emission Factor Charcoal Making**	**Units**	**Estimated Emissions Savings from Charcoal Making (t/y)**
TSP	2.3	g/kg of charcoal produced	11
NO_X	0.066	g/kg of dry wood consumed	1.9
CO	70	g/kg of dry wood consumed	2000
CO_2	440	g/kg of dry wood consumed	13000
CH_4	11	g/kg of dry wood consumed	320
NMHC	3.0	g/kg of dry wood consumed	88

[24] TSP emission factor taken from Ellegård & Egnéus (1992). Emission factors for other pollutants were taken from a compilation of emission factors for wood- and charcoal-fired stoves (Bhattacharya et al., 2002).

[25] TSP emission factor taken from Smith et al, (1998). Other emission factors are taken from Innes (2000) with a typical Ghanaian wood moisture content taken from Flemming (2000).

Table A-7: Net Emission Savings Estimates due to LPG Combustion[26]

Pollutant	Displaced Wood and Charcoal Emissions (t/y)	Emissions due to LPG Combustion (t/y)	Estimated Net Displaced Emissions[27] (t/y)
TSP	38	0.0	38
NO_X	3.2	7.6	-4.4
CO	2800	5.9	2800
CO_2	27000	5200	22000
CH_4	380	1.1	380
NMHC	130	1.1	130

Labour/time savings

Collection of firewood is a time consuming task. Literature for Ghana indicates that 3.5 h/d to 4 h/d are spent collecting fuel wood and that one day's search provides wood for three days (Njie, 1995). The beneficiaries of the time savings associated with a switch to LPG from fuel wood are often women and children, who can use the time for other beneficial activities such as income generation or education. However, only 9% of household in Accra (the current customer base) use wood for fuel (UNDP, 2003). According to the project partners, the company services a population of approximately 30 000 (i.e., potentially 2 700 beneficiaries). No further data regarding the labour/time savings associated with Anasset are currently available.

It should be noted that Ghana sees the dissemination of LPG to rural areas as a focus of its official energy related development policy (WB, 2003a) and this is therefore consistent with Anasset's long-term plans to expand into rural areas.

Increased personal/household income

UNDP (2003) indicates that the monthly fuel cost for a typical family using LPG (USD 6.40) is higher than that of a family using charcoal (USD 5.80) or firewood (USD 5.30) but lower than a family using kerosene (USD 10.00). No data regarding the number of households serviced by Anasett are currently available.

[26] LPG combustion emission factor for CO_2 from (IPCC, 2003). All other emission factors were taken from Kleeman Aldershot (1994) in a review of relevant factors from the Öko-Institute (Öko-Institut, 2003). The heating value of LPG was taken from LPGA (2003).

[27] All figures in the table are expressed as two significant figures. Therefore, calculations of net displaced emissions based on values in the table may not correspond with those listed.

Enterprise – GTEL

GTEL is a venture, which has been in operation since 1999. Its core business is selling mostly compact fluorescent products (CFLs). The company has established a solid customer base and is now experiencing growth. GTEL received a loan to purchase more products and facilitate expansion of the business.

Financial Assistance

USD 70 000, 3.5 y payback at 7.5% p.a.

Non-Financial Returns

Job creation
The company consists of 11 permanent employees (3 managers, 1 security guard and 7 office/sales staff). Casual labour is employed depending on variations in sales volume. The product leads to cost savings for customers. This could potentially lead to increased further employment although no data are currently available.

Job creation through "creating an enabling environment to stimulate private sector activities" is considered an important objective of Ghana's official poverty reduction strategy (WB, 2003a)

Electricity savings
Most of the products sold by GTEL have the primary purpose of reducing electricity consumption. According to the project partners, electricity savings from these devices range from about 50% to 90% on devices between 40 W and 100 W. 58 731 units were sold from January to July 2003 comprising of a mixture of single bulbs, complete packages (including fittings) and a few single accessories. Assuming that each unit consists of a device between 8 W and 20 W and similar sales for the second half of 2003, between 2 300 kW/y and 11 000 kW/y are being saved as a result of Anasset's operations. Assuming each device is being used for 8 h/d, between 6.7 GWh/y and 32 GWh/y are being saved as a result of Anasset, which is equivalent to between 0.12 % and 0.58 % of national electricity consumption[28].

Fossil fuels account for 30% of electricity production in Ghana although traditional fuels account for 78.1% of total energy consumption (Nationmaster.com, 2003)

Cost savings
The customers of GTEL save money as a result of the installation of the control equipment. However, no data regarding these savings are currently available.

[28] 5.484 billion kWh/y of electricity consumed in Ghana (Nationmaster.com, 2003).

Enterprise – AME

AME is building a business servicing solar hot water systems in Senegal and signed a loan agreement during the first quarter of 2002. The loan has been advanced to help AME build a portfolio of service contracts and further expand the business.

Financial Assistance

USD 41 563 loan, 3 y payback at 11% p.a.

Non-Financial Returns

Job creation
AME comprises of six employees: 2 administrative officials, 2 technicians, 1 commercial assistant and 1 housekeeper. No significant indirect employment effects are expected.

Fossil fuel substitution
Using solar energy displaces electricity/heat that would otherwise be consumed. AME services approximately 250 residential customers plus a number of commercial customers. No data are currently available regarding the number of commercial customers, however, using the residential customers as a basis and assuming an average collector area of 2 m^2, it is estimated that 2500 MWh/y of solar-based energy is delivered[29]. Senegal's electricity consumption of 1.2 TWh is entirely fossil-fuel based (LAMNET, 2003). However, electricity consumption represents only 12% of the country's energy consumption with the majority (53%) of the country's consumption being due to household consumption of wood or charcoal and most of the remainder (34%) comprising of petroleum consumption (Sokona, 2003).

Also, Senegal's official poverty reduction strategy does not identify fossil fuel substitution as a priority, but instead focuses on:

- Development of production capacities (promotion of electric power use in productive activities);
- Development of energy infrastructures and services through involvement of the private sector, village associations and local authorities;
- Ensuring the financing of development activities for the energy subsector;
- The diversification of energy sources;
- Improvement of and ensuring the population's access to household fuels, and
- Strengthening of rural electrification.

The support of this enterprise does therefore appear to be broadly consistent with development objectives.

[29] Energy consumption data (500 kWh/m^2.y) and average collector area (assumed to be at the low end of the range for Mediterranean systems – 2 m^2) taken from UNDP (2000).

Enterprise – VEV

VEV is a small company that has found a market niche in the repair and maintenance of wind-powered water pumps in Senegal. There is a good market for this service, as about 90% of such pumps in the country are not working. Although the company has operated profitably during the last eight years, a lack of working capital has limited the company's capacity to stock inventory and therefore to provide an efficient maintenance service. With a loan and enterprise development support, VEV is expanding its inventory and purchasing an additional vehicle to shorten service times and will soon begin offering short-term credit to qualified clients.

Financial Assistance

USD 17 831 loan, 5 y payback at 12.0% p.a.

Non-Financial Returns

Job creation
VEV comprises of 15 employees: 3 administrative, 10 technical, 1 driver and 1 housekeeper. Additionally, as a result of a reliable and continuous water supply, indirect jobs for entrepreneurs that sell water from the public pipes have also been created. No data relating the number of these jobs are currently available.

Also, the time/labour saving benefits (see below) in the community is likely to lead to some beneficial indirect employment effects, although no data to this end are available.

Also, anecdotal evidence from the project partners suggests that, due to the management and financial support, VEV's increased capacity to service more clients is creating a greater demand for locally-made materials such as pipes, iron rods, cables, stems, tubes, valves and other assorted metal objects, which has in turn stimulated job creation needed for production of those goods. Again, no further quantifiable data are currently available.

Increases in personal income are a central objective in Senegal's official poverty reduction strategy (WB, 2002).

Labour/time savings
Improved productivity, especially in rural areas, is considered an important part of Senegal's official poverty reduction strategy (WB, 2002).

The pumps serviced by VEV allow people to save time and labour associated with water carrying. In Senegal, women and children spend up to 4 h/d (according to the project partner) collecting water, a physically demanding task. Literature for Senegal indicates that between 4 h/d and 5 h/d are required for fuel collection, with carrying distances of up to 45 km (Njie, 1995). A working pump allows them to spend this time on other activities beneficial to the household such as income generating activities or education.

Based on data from the project partner, VEV has approximately 100 pumps under service at the moment, servicing a population of between 30 000 and 100 000 people. Assuming an average household size of 10 people (WB, 2003b), and that one person in each household is responsible for water collection, this equates to savings of between 12 000 h/d and 40 000 h/d.

Increased personal/household income
Wealth creation is a key objective in Senegal's official poverty reduction strategy (WB, 2002).

In rural Senegal, many villages have started communally-owned businesses that sell buckets of clean water to local households. It is estimated by the enterprise, that after maintenance costs, the average village income is between approximately USD 320/y and USD 635/y (AREED (2002) in Milton (2002)). The project partner estimates that VEV services approximately 100 villages at any one time, leading to an approximate indirect village income of between USD 32 000 and USD 63 500.

Also, according to the project partners, in some villages with VEV-serviced windmills, people are able to enhance agricultural output by utilising water for irrigation and better upkeep of livestock. These gains in productivity are then likely to be felt in terms of increased household income although no data to this effect are available.

Fossil fuel substitution
VEV has, at any one time, 100 pumps under service. At an average energy consumption 500 W, and assuming continuous operation, VEV is displacing a maximum of 438 000 kWh/y of fossil fuel generated electricity. Senegal's electricity consumption of 1.2 TWh is entirely fossil-fuel based (LAMNET, 2003), meaning that about 0.034% of Senegal's electricity consumption is being displaced. Also, electricity consumption represents only 12% of the country's energy consumption with the majority (53%) of the country's consumption being due to household consumption of wood or charcoal and most of the remainder (34%) comprising of petroleum consumption (Sokona, 2003).

Also, Senegal's official poverty reduction strategy does not identify fossil fuel substitution as a priority, but instead focuses on (WB, 2002):

- Development of production capacities (promotion of electric power use in productive activities);
- Development of energy infrastructures and services through involvement of the private sector, village associations and local authorities;
- Ensuring the financing of development activities for the energy subsector; (iv) diversification of energy sources;
- Improvement of and ensuring the population's access to household fuels, and
- Strengthening of rural electrification.

The support of this enterprise does therefore appear to be broadly consistent with the country's development objectives.

Health benefits of reliable water supply
Improving the living conditions of vulnerable groups is a key aspect of Senegal's official poverty reduction strategy (WB, 2002).

Villages without working windmills often have no reliable source of safe drinking water, as they are often reliant on uncovered wells that became contaminated. A fully operating wind-powered water pump significantly reduces transmission of water-borne diseases, to the benefit of the children and the elderly who usually bear burden of such illnesses (Sarr (2002) in Milton (2002)). No data on the reduction in illnesses or improvement in health is currently available.

The potential increased agricultural productivity is also anecdotally linked to an increase in general health through better nutrition. No specific data regarding this observation are currently available.

Further, achieving food security is part of Senegal's *Priority Action Plan* outlined in its official poverty reduction strategy (WB, 2002).

The establishment of a reliable water supply to approximately 100 villages has fostered the development of a number of collective vegetable gardens. These gardens lead to a more reliable food supply for the villages and are evidence of improved food security.

Enterprise – La Esperanza

La Esperanza the location of a 1.2 MW hydro power station that was given management support to enable the development of a viable business plan. Seed capital was also provided together with support in identifying co-financing and relevant contacts within the Ministry of Environment.

Financial Assistance

USD 250 000 loan, 6 y payback period, at 12% p.a.

Non-Financial Returns

Avoided deforestation or reforestation
Deforestation leads to environmental impacts such as loss of biodiversity, erosion and salinity. Deforestation can also cause local impacts on nearby communities that use the forest as a source of fuel or food.

According to FAO (2003), deforestation in Honduras is approximately at a rate of approximately 1.03% (59 000 ha/y). Deforestation is mainly due to the clearing land for agriculture and the collection of firewood and is considered to be a problem deserving high priority in the country's official poverty reduction strategy (WB, 2001).

As part of a community commitment, the company planted a total of about 27 000 plants of different species such as oak, yellow plum, arrayán, manzanita de agua, eucalyptus, white pine, ornamental pinabete, cedar and mahogany. An equivalent area of these plantings could not be estimated for this study.

Job creation
The construction of the plant involved 40 temporary jobs and the completed plant consists of ten permanent jobs that are all supplied by the local community.

Fossil fuel substitution
The use of hydropower avoids the need for the consumption of fossil fuels for the generation of electricity. According to the project partners, approximately 7.5 GWh/y of hydropower is expected from this installation (0.21% of national electricity consumption[30]).

In Honduras, 37% of electricity is generated from fossil fuels. However, traditional fuels contribute 55% of energy consumption (Nationmaster.com, 2003).

Electricity supply
The company has planned to support the electrification of the nearby (and rural) communities. However, this electrification has not yet taken place and is conditional upon the profitability of the company.

Improving access to electricity is considered an important part of Honduras' poverty reduction strategy (WB, 2001).

Infrastructure improvement
The construction of the hydro power station was associated with an improvement of roads to the area. This improvement gives the nearby community better road access to important services in more

[30] Electricity consumption in Honduras of 3.593 billion kWh/y (Nationmaster.com, 2003).

populated areas (e.g., health). No data on the impacts of this improvement in roads is currently available.