

**Towards an appropriate framework for South African rural renewable
energy provision**

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(Sustainable Development, Planning and Management) at the University of Stellenbosch



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DECLARATION

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and that I have not previously in its entirety or in part submitted it at any university for a degree.

Signature:.....

Date:.....

Abstract

Sustainable energy provision is regarded as one of the most significant development challenges in South Africa, where a large proportion of the population still lacks access to energy services. Efforts at addressing this situation have encountered substantial problems. The *Intermediate Technology Development Group* (a.k.a. *Practical Action*) has developed a manual that seeks to address these issues; the *Renewable Energy for Sustainable Rural Livelihoods* workgroup has also developed such a framework that makes use of computer-modelling. Both these frameworks rely heavily on the Sustainable Livelihoods theoretical framework and have been integrated and assessed in terms of their applicability for South African rural renewable energy through a Delphi study conducted with several experts in the industry. The results indicate that the integrated framework is suitable for the South African context, with several additions suggested.

Opsomming

Die volhoubare voorsieining van energie word beskou as een van die belangrikste ontwikkelingsuitdagings in Suid-Afrika, waar 'n aansienlike deel van die bevolking steeds nie toegang het tot energie-dienste nie. Pogings om die probleem aan te spreek word gekenmerk deur ernstige probleme en tekortkomings. Die "Intermediate Technology Development Group" (huidiglik bekend as "Practical Action") het 'n handleiding saamgestel wat poog om die kwessies aan te spreek. "Renewable Energy for Sustainable Rural Livelihoods" is 'n werkgroep wat ook die kwessie aanspreek met behulp van rekenaar-gebaseerde modelle. Beide die raamwerke is gebou op die "Sustainable Livelihoods" teoretiese fondasie en word vir die doel van hierdie tesis geïntegreer en assesser d.m.v. 'n Delphi studie, uitgevoer met verskeie kundiges in die veld. Die resultate dui aan dat die geïntegreerde raamwerk toepaslik is vir die Suid-Afrikaanse konteks, met verskeie aanvullings wat aanbeveel word.

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Had it not been for the life-long ongoing support provided me by my parents, Anton & Retha Kruger, this thesis would never have seen the light. The Fabricius family, in particular Marilize Fabricius, deserves a particularly special acknowledgement as well for the ongoing enabling role that they played in my life.

Lastly, but definitely not least, I acknowledge and dedicate this work to my Heavenly Father, God Almighty, who gives me breath and life: may this thesis as well as every breath I take serve to exalt Your Name.

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List of Abbreviations

CAP	Community Action Plan
CSIR	Centre for Scientific and Industrial Research
DFID	Department for International Development
DME	Department of Minerals and Energy
EIA	Environmental Impact Assessment
FAO	Food and Agricultural Organisation
GDP	Gross Domestic Product
ITDG	Intermediate Technology Development Group
IP	Internet Protocol
IRR	Internal Rate of Return
LPG	Liquid Petroleum Gas
NGO	Non-governmental Organisation
NPV	Net Present Value
PM&E	Participatory Monitoring & Evaluation
PRA	Participatory Rural Appraisal
PV	Photo-Voltaic
RE	Renewable Energy
RESURL	Renewable Energy for Sustainable Rural Livelihoods
SLF	Sustainable Livelihoods Framework
STEP	Social, Technological, Environmental and Political Assessment
SURE	Sustainable Rural Energy
SURE-DSS	Sustainable Rural Energy Decision Support System
SWOT	Strengths, Weaknesses, Opportunities, Threats
UNDP	United Nations Development Program
URL	Uniform Resource Locater

Chapter 1: Introduction

1.1. Background/Rationale of the Study

In light of the almost universal acceptance of the Millennium Development Goals (UN, 2005) the growing awareness of Climate Change (UN, 2007) and an increasing concern of an Oil Peak as oil prices continue in a general upward direction, the search for renewable energy (RE) has become a matter of great urgency, especially in rural areas where the bulk of the poor still find themselves. This is important especially in relation to the Millennium Development Goals, where energy poverty and its related consequences are highlighted as one of the main problems that needs to be addressed by 2015 if most of the goals set by the United Nations are to be met (Karekezi *et al.*, 2002).

In South Africa, this drive for RE is given further weight through the commitment made in the constitution through the mechanism of human rights in terms of access to electricity for all citizens; as does the enormous costs involved with utility-based grid provision in rural areas (Reiche *et al.*, 2000). Also, the White Paper on Renewable Energy calls for 10 000 GWh of energy to be produced from renewables by 2013 (DME, 2003).

Despite this enormous drive for RE, the literature seems to suggest that renewable energy projects are quite prone to failure, especially in remote areas (Morgenstern, 2002). The World Bank's experience throughout the world highlights the fact that the interaction between society and renewable energy technology is one of the critical factors of success that needs to be actively managed if sustainable energy development is to be achieved. Some of the prevailing challenges listed by the World Bank (2004: 38) include: "...perceived financial and political risks, insufficient institutional capacity to implement projects, weak or inadequate regulatory frameworks, and limited understanding of what is feasible on the ground".

This realisation is confirmed by Mapako (2006), who has done an in-depth study of renewable energy delivery models in Southern Africa and has found that socio-political factors are on par

with their economic and technical counterparts when it comes to the sustainability of renewable energy projects. Most of the cases that Mapako studied reveal a general failure of rural electrification efforts using renewable energy sources. Additional studies on rural electrification in Zimbabwe (Mapako and Afrane-Okese, 2002), particularly using renewable technologies, also show that institutional support, knowledge transfer and technical support are key factors in sustaining technology transfer. This is especially true in the case of high-tech-technology, such as photovoltaic cells.

Both the World Bank's experiences, in general, as well as Mapako's specific experience in Southern Africa suggest that there are truly significant challenges to transferring renewable energy to rural areas. These challenges are found within technical/technological, social, economic and institutional spheres and illustrates the fact that renewable energy implementation with the purpose of rural development requires a holistic, integrated approach.

Even at the Renewable Energy Forum (2000), hosted by the Australian Agency for International Development, pertinent mention was made of the fact that "...the *remains* of renewable energy projects can be found throughout the developed and developing world" (own emphasis added).

However, despite this seeming large-scale failure of rural renewable energy, there have been a number of important successes as well, especially on the African continent. In fact, Kenya is now the world's largest "solar nation", with around 20 000 privately installed and -used photovoltaic (PV) systems being utilised (Solar Electric Light Fund, 2001). This excludes the public provision of Solar PV in the country. Mapako (2006) estimates that between 60% and 80% of the 85 000 solar systems in Zimbabwe are functional, while 16 PV water pumping sites and 650 wind pumps have been installed successfully.

What has emerged from all of these cases is the fact that merely installing a RE technology in a rural context is not enough and that an integrated approach is essential for rural RE provision. Identifying what such an approach may look like is the purpose of the literature study. When such an approach has been identified, it will be tested in the South African context through an

online Delphi study where experts from across the South African renewable energy landscape will evaluate this framework.

1.2. Research Objectives

The main aim of the research is to determine whether an established framework may be appropriate to facilitate sustainable decision-making of rural energy in the South African context. In light of this aim, the following 2 main objectives have been identified and formulated:

- Identify an established framework for sustainable decision-making of rural energy in South Africa based on the literature.

- Determine the appropriateness of the identified established framework for the implementation of energy projects in the South African rural context:
 - Identify the main shortcomings of the established framework;
 - Identify the main virtues of the established framework; and
 - Identify possible adjustments and additions that can be made to the established framework.

The research proposition is that an available framework is suitable to facilitate the implementation of energy in rural South African settings. Proving this is what this document aims to do.

1.3. Research Strategy

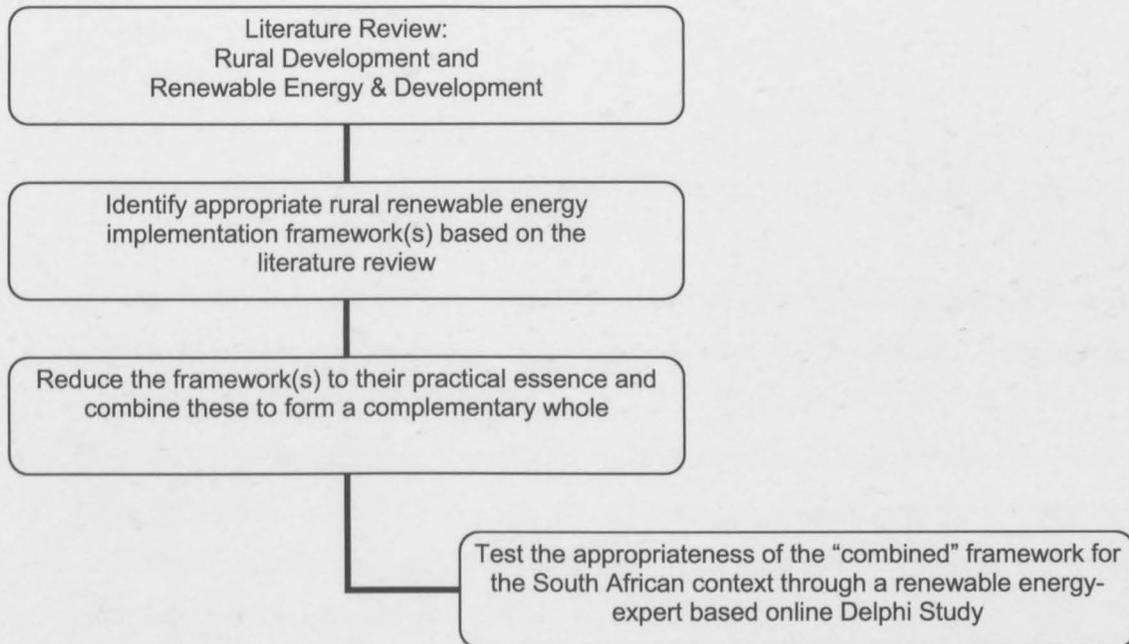


Figure 1.1: Research Strategy

Chapter 2: Literature Review

2.1 Outline

The literature review consists of three main parts:

- Rural development, which focuses mainly on current rural development thinking and theories;
- Energy for rural development, where the role of energy, especially renewable energy, in the rural context is asserted and a summary of failures and lessons learned with rural renewable energy projects is provided; and
- Decision-making models, where the two aforementioned domains “formally” meet each other in the two relatively distinct forms of a sustainable decision-making framework, and a decision-support system which are both products of the integration of current rural development thinking and renewable energy innovations.

These 3 parts constitute the main focus areas of the literature study to highlight the established frameworks, the overall goal of the research.

2.2 Rural development

The field of development has seen the slow devolution of developmental theories and associated programmes to the decentralised, local level. Where the stages of growth- and dependency theories rested on assumptions of homogeneity in societies across the world, theories that are more “people-oriented” and sensitive to local conditions were introduced as the “homogenous” societies of the aforementioned theories failed to respond to standardised development “assistance”. Along with this, theories of the role of the state, the market and civil society has, in tandem with the end of the cold war, moved completely away from centralised state planning to the exact opposite: neo-liberal market fundamentalism, with globalisation and free market economics being held up as the panacea for struggling developing nations. Recently, however, even in development economics there has been more of a shift towards the “middle”, where a

more decentralised state provides the support for the market and especially a more emergent and locally sensitive civil society (Tembo, 2003: 2-3; Davids *et al.*, 2005: 4 – 29; Easterly, 2002).

The literature on rural development is in agreement with the overall stance in developmental circles that decentralised, locally-sensitive, civil society (community)-led interventions are needed for the sustainability of development (Singh, 1986: 18 - 19; World Bank, 1997: 1 – 19; Opare, 2007: 251; Shriar, 2007: 275; Lichtman, 2003: 23). However, rural development, as defined by Singh (1986: 18) refers to “...a process of developing and utilising natural and human resources, technologies, infrastructural activities, institutions, organisations and government policies and programmes to encourage and speed up economic growth in rural areas, to provide jobs, and to improve the quality of rural life towards self-sustenance”.

This definition is based on the dangerous assumption that economic growth leads to an improvement in quality of life. Recent development literature is very critical of developmental theories that equate economic growth with improved quality of life, opting rather for developmental approaches that make use of broader and more people-oriented theories of poverty and development, such as sustainable livelihoods and human development (Davids *et al.*, 2005: 4-29; 37-41).

The goal of rural development is also much more contentious than suggested by Singh's definition. Again, recent trends in development have highlighted the need for community-led approaches to development if it is to be truly sustainable, therefore the goal of a specific developmental action is to be determined by those affected by it (Davids *et al.*, 2005: 112; The World Bank, 1996: 3; 193). Also, the fruit of stating self-sustenance as the ultimate goal of development not only diminishes the importance of dimensions other than the material, but it also creates the impression that once a community is able to sustain themselves, they are no longer in need of developmental assistance. This assumption carries within it the seeds of its own destruction since it implies that development results in a community with no dependence on outside assistance, thereby relieving the state of its developmental responsibility once a certain state of equilibrium has been reached; in essence, a closed system.

Although his overall definition of rural development is partly flawed, Singh (1986) makes a very valuable contribution in distinguishing between the conceptual, phenomenal, strategic and disciplinary definitions of rural development. This serves in establishing a much more thorough understanding of the concept as well as its constituent parts and seems to be much more in tune with current developmental theories than the aforementioned definition. This multi-dimensional definition forms the skeleton that the rest of the literature review is based on.

2.2.1 Rural development as a concept

“(Rural Development) connotes the overall development of rural areas with a view to improve the quality of life of rural people. In this sense it is a comprehensive and multi-dimensional concept...” (Singh, 1986: 18).

2.2.1.1 Complex systems theory

The fact that rural development is so multi-dimensional, with so many interactions among the constituent parts, means that it can be defined as: the interactions of a complex system. Rural development can also be conceptualised as two or more systems interacting with each other, with the goal of increasing the robustness of the “weaker” system. While only still at the conceptual level of definition, there are a large number of very important and potentially practically useful characteristics of complexity and systems theory that can greatly assist those engaged in rural development.

Systems theory was established as a scientific theory in the 1950's by Ludwig von Bertalanffy in his foundational text “General Systems Theory”. A system is defined by Banathy (1996) as “...a configuration of parts connected and joined together by a web of relationships.” Complexity theory, which has its roots in chaos theory, opens up a whole new world of possibilities when it collides with Systems theory, and Complex Systems are “created”. Complex systems are systems which, according to Cilliers (1998), “...consist of many variables in an open system with non-linear relationships that cannot all be described, explained and predicted with accuracy”.

The characteristics of complex systems (Cilliers, 1998:3; wikipedia.com, 2007) that are of relevance for rural development, are the following:

- Relationships are non-linear:
 - This characteristic immediately undermines the predictability of interventions, making local knowledge and long-term involvement essential for success.

- Relationships have feedback loops:
 - These feedback loops can either be negative, maintaining the status quo, or positive, resulting in an ever dynamic state of change. The challenge is to be able to change negative feedback loops that maintain an undesirable status quo into positive feedback loops, i.e. sustainable development. This is what is meant by Mosse (2005) when he refers to the practise of “cultivating development”. It is also important to be wary of those positive feedback loops that may undermine development and result in a downward spiral. Proper preparatory assessment is therefore essential.

- Complex systems are open:
 - This characteristic is essential for the maintenance of any system. Without interaction with other systems, such a system will be unable to maintain its complexity, thereby reducing its available response options. This phenomenon is not only limited to the natural realm, but applies to all complex systems.

- Complex systems have a memory:
 - The history of complex systems may be important since complex systems are dynamical and previous states may influence the system’s current state. Again, the importance of local knowledge and stakeholder involvement is implied through this.

- Complex systems may be nested:

- This refers to the fact that that a complex system may be made up of a number of smaller complex systems. This is particularly evident in social systems, where almost each constituent part is made up of and forms part of a number of other complex systems.

- Boundaries are difficult to determine:
 - This follows from the openness and nested characteristics of complex systems and is one of the areas where project-led rural development and complex systems collide head-on: projects commonly need to operate within distinct time frames and geographical spaces (especially in the rural context). However, these boundaries usually result in certain parts of the system being excluded, creating the possibility for unwanted unforeseen consequences.

- May produce emergent phenomena:
 - These are phenomena that are not evident from the characteristics of the constituent parts alone, but are the product of the system itself and therefore needs to be studied at a higher level.

Gallopin (2003: 17 – 18), when investigating sustainable development from a systems theoretical position, identifies the goal of sustainable development as “increased complexity”. It is this increased complexity that increases a system’s available range of options, ensuring greater robustness in the face of the complexity of other systems that it forms part of. It is however extremely important that the correct system, with all of its constituent components, be recognised and engaged with. Failure to do so may increase the likelihood of failure since unforeseen spin-offs and decreased complexity are more likely to occur. What is therefore implied by complex-systems theory in general, and by Gallopin in particular, is the need for a very holistic, integrated approach to rural development.

2.2.2 Rural development as a phenomenon

Singh (1986: 18) continues with his definition of rural development by looking at it as a phenomenon, where he identifies it as "...the result of interactions between various physical, technological, economic, socio-cultural and institutional actors".

These multi-faceted interactions strongly correlate with the definition given by Schueler (1997) of complexity as "...a large number of interrelated parts". The fact that these parts are interrelated means that the isolation of any one of these parts or dimensions in search of development translates into an important fallacy that is bound to have unforeseen consequences. This again correlates with the realisation of the World Bank, which calls for broader and more inclusive approaches to rural development that is not restricted to the traditional conception of mere agricultural assistance (World Bank, 1997: 17).

2.2.2.1 Participation

The aforementioned interaction among actors also introduces the need for participation, or, to be more precise, participatory development. According to Burkey (1993: 33) to bring about sustainable human development: "...people's participation in designing, implementing and evaluating rural development programmes and policies (is necessary)". Participation as both a means to development as well as an end in itself due to the inherent qualities found within the practise (when interpreted as an active, strong, empowering practise) has made it an essential part of any developmental strategy (Davids *et al.*, 2005: 114 - 119).

This is evident by the way in which participation has been embraced by NGO's, developmental agencies such as the World Bank, as well as governments all over the world (FAO, 2001; Etherington, 2002; Canadian Rural Partnership, 2002; Van Zyl *et al.*, 1995). So-called participation is being used in environmental assessment in Canada (Hunsberger *et al.*, 2005) to determine environmental policy in the USA and Canada (Van Nijnatten, 1999), to identify sustainability indicators in Western Canada, Botswana and the UK (Fraser *et al.*, 2006) and to facilitate the World Bank driven development projects all over the world (World Bank, 1996).

However, there is currently an important debate raging in development circles concerning the definition and practise of true participation. There has developed such dissatisfaction with participation that Cooke and Kothari (2001) argue that participation has become merely another method of control that creates the illusion of legitimacy and empowerment, but in reality merely serves in further oppressing those that are supposed to be empowered.

This viewpoint is supported by Craig and Porter (1997), who conclude that a fundamental change is needed in the way that participation is perceived and implemented since the tools of participatory development can result in either control or participation, depending on how they are utilised. Or as Havel (The World Bank, 1996: 1) states: "It is not that we should simply seek new and better ways of managing the economy and the world. The point is that we should fundamentally change how we behave". Davids *et al.* (2005: 204) also adhere to this viewpoint, claiming that "in authentic development an assisting agency is a participant in a development process that is community driven, community led and community owned – basic conditions for sustainability".

The aim of participatory development is self-sustaining development (Davids *et al.*, 2005: 204), which links with Singh's initial definition of rural development as a move towards self-sustenance (Singh, 1986: 18). However, there are two important differences: self-sustenance does not imply continual improvement, but rather a state of equilibrium. Also, whereas self-sustenance is seen as the end, or goal, of rural development by Singh, Davids *et al.* (2005) see development as a continual process, with the goal of participation being to have the process be self-sustaining. It is thus fundamentally about empowering the community to determine the course of their development and carry it out, which, according to the proponents of participation, creates a process that sustains itself (The World Bank, 1996: 3; 33; 193; Davids *et al.*, 2005: 204).

In the rebuttal of Cooke *et al.*'s (2001) dismissal of participation as developmental practise, Hickey and Mohan (2005) illustrate that "true" participation can serve in bringing about genuine transformation for those most in need of it.

This “true” participation, as defined by Davids *et al.* (2005: 19 – 20), refers to a two-way, bottom-up approach that differs from consultation or involvement in that the beneficiaries are empowered; participation therefore takes place during decision-making, implementation, monitoring and evaluation, and the sharing of benefits. The benefits of such an approach include:

- Greater acceptance of development activities (ownership);
- The inclusion of marginalised groups;
- The promotion of self-reliance;
- Capacity building and empowerment;
- The collection and dissemination of accurate information; and
- The creation of the necessary conditions for cost recovery.

“The process of participation empowers individuals...” (The World Bank, 1996: 233). One of the main goals of participation, empowerment, is defined specifically as “power to” and “power from within”, not “power over” (Davids *et al.*, 2005: 21). Whereas “power to” implies a means to an end, in this case sustained development, “power from within” refers more to an end in itself, which illuminates the insistence on participation as a means to an end as well as an end in itself.

2.2.2.2 Social Learning

In as much as participation is a means to an end, it feeds into the Social Learning approach, which is defined by Davids *et al.* (2005: 20 – 21) as “conscientisation – a critical awareness of one’s potential to initiate and manage positive change for the benefit of oneself and others.” Accordingly, social learning is closely linked with empowerment and self-reliance. Keen *et al.* (2005: 1) also illustrates the multi-faceted linkage of this concept with development practise in that: “... the five core strands of activity integral to the social learning approach and its agendas...are reflection, systems orientation, integration, negotiation and participation”.

The goal of rural development, “self-sustained development”, is therefore regarded as a product promoting the “agendas” of social learning, which are the creation of “...learning partnerships,

learning platforms and learning ethics that support collective action towards a sustainable future” (Keen, 2005: 1). Learning is seen as a two-way phenomenon, allowing the integration of the “developers” into the process and enabling all parties to learn as progression takes place. It is partly through this process of social learning that participation is able to be translated into empowerment.

2.2.2.3 Technology Transfer

Within the dynamic interaction between actors in rural development described by Singh, space (and trust) is created for exchange (learning, two-directional) and transfer (one-directional). One such necessary transfer is that of technology. In as much as development is concerned with the improvement of the material quality of life and income generation, the need for technology transfer is created. This has also proven to be of the costliest and most complex exercises in development, since tangible goods with monetary value are many a time “transferred” into rural settings where their value is lost due to the unsustainability of the projects (Mulugetta *et al.*, 2005: 4-5).

There seems to be no standardised set of rules for successful technology transfer to rural areas, yet “...there is widespread recognition of the importance and role of trust in facilitating regional development (and) technology transfer” (Murphy, 2006: 427). This enabling trust is a product of meaningful engagement between the different actors involved in the transfer, again highlighting the importance of participation. Obviously, the technology also needs to be well-maintained, rugged enough to survive in rural settings, relatively simple if full-time maintenance is not available and well-suited to the needs of the community (Mulugetta *et al.*, 2005: 9 - 25). These are some of the conditions specifically relevant to rural energy technology transfer, yet it still needs to be integrated with all other sectors of rural development if the transfer is to be successful (Mulugetta *et al.*, 2005: 1-8).

2.2.3 Rural development as a strategy

Rural development as a strategy is "...designed to improve the economic and social well-being of a specific group of people – the rural poor" (Singh, 1986: 18).

The importance of the strategic definition of Rural Development lies in the identification of the poor as those that are supposed to be at the receiving end of rural development, as well as the fact that his definition of poverty alleviation (i.e. rural development with the aim of helping the poor) includes their social well-being, in addition to the traditionally sighted economic dimension.

2.2.3.1 Poverty

"For the poor, poverty is a multi-faceted reality consisting of, inter alia, lack of power, income and resources to make choices and take advantage of opportunities" (Davids *et al.*, 2005: 37).

Gaining an understanding and "workable definition" of poverty is not an easy task, as it is a complex phenomenon. "Poverty is perceived differently by different people, some limiting the term to mean a lack of material well-being and others arguing that lack of things like freedom, spiritual well-being, civil rights and nutrition must also contribute to the definition of poverty" (Kabubo-Mariara *et al.*, 2004: 6). Accordingly, there are a number of different perspectives of poverty used by different entities involved in development. Davids *et al.* (2005: 37 – 41) provide a brief taxonomy of these different perspectives, which has been summarised below.

The most well-known perspective is the Income perspective, which is a purely an absolute (as opposed to a relative) and materialistic measure of poverty that defines poverty according to certain agreed upon levels of income, GDP and employment. Although useful due to the fact that it enables quantification and is considered to be an objective measure of poverty, it is a very narrow concept and ignores all other dimensions of poverty. This perspective is quite popular among government agencies and is also the breeding ground for purely growth and employment led poverty reduction strategies (Davids *et al.*, 2005: 37 - 39).

A close “cousin” of this perspective is the basic needs approach. Although more comprehensive in its definition of poverty and strategies needed to address that issue, it also focuses on physiological deprivation. The logic of this approach is that physiological needs constitute the basic level of poverty and need to be addressed first. This includes, for example, access to water and sanitation, food and shelter. Once these needs have been met, non-material “basic needs” such as literacy and life-expectancy can also be addressed. Although this perspective is more relevant to the rural context and enables the creation of improved policies and programmes aimed at poverty reduction, it still fails to acknowledge the multi-dimensional, complex nature of poverty.

An approach that originated in the developed world and is used much within that context is called Social Exclusion, and primarily makes use of the level of exclusion as the main measure of poverty. This perspective is built on the assumption that the material level of poverty has more to do with inequality than with survival; it is therefore not an absolute measure of poverty, as with the previous two perspectives, but rather a relative, or relational measure of poverty. Power and its relational consequences are the main concern of this perspective. Although this perspective is a valuable contribution to understanding and responding to poverty, it nevertheless seems to represent the other extreme, which neglects the material dimensions of rural poverty.

A perspective that incorporates all of this and more is the Human Development approach, used mostly by the United Nations with its Human Development Index as the measure of poverty. This approach sees poverty as “...the denial of choices and opportunities for a tolerable life” (UNDP in Borat *et al.*, 2004: 1) and development is consequently concerned with “...enlarging the life choices of people.” (Davids *et al.*, 2005: 40).

For a large organisation such as the United Nations that has access to a myriad of resources, an approach like this makes sense. However, for smaller organisations such as grassroots NGO’s, which are primarily the developmental agencies involved in rural development, and even resource-strapped governments, such an approach may merely result in passivity. Although this

is a very comprehensive measure of poverty, it does not easily allow for meaningful action at both the macro- and micro-levels.

This is where the Sustainable Livelihoods approach appears: “A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels in the long and short term” (The Institute of Development Studies, 2001: 53).

The approach is very much focused on the subjective understanding and experiences of impoverished communities, focusing on local resources and constraints and aiming to address them: “To obtain an adequate definition of poverty requires involvement of the ‘poor’ themselves” (Wratten, 1995: 16).

When using this approach as a developmental framework, there is much room for manoeuvrability since it constantly allows for learning and adaptation, and works with what people already have. The primary concern of the Sustainable Livelihoods approach is to decrease the vulnerability of communities; an increase in the choices/options of the concerned communities is therefore required (signalling a convergence with Gallopín’s system definition of Sustainable Development). In the words of Reid and Vogel (2006) “the SLF (sustainable livelihoods framework) is primarily concerned with people and how their assets in the form of various ‘capitals’ (e.g. social, physical, natural, human) enable them to achieve positive livelihood outcomes”.

It is therefore not as simple as merely increasing the level of income or the amount of jobs in the community. Instead, problems such as alcoholism, the break-down of family structures and crime are used as indicators of both the causes and effects of rural poverty. The subjective approach allows for the addressing of issues that are important to local communities and is therefore better able to deliver long-term, sustainable development that truly benefit the poor.

2.2.4 Rural development as a discipline

“As a discipline, it is multi-disciplinary in nature representing an intersection of agricultural, social, behavioural, engineering and management sciences” (Singh, 1986: 18).

2.2.4.1 Transdisciplinarity

The multi-disciplinary approach propagated by Singh has of late been replaced with, or rather complemented by, transdisciplinarity. The term was introduced in the 1970's by Jean Piaget (as cited in Nicolescu, 2003) and was defined as a way of thinking that “...would not be satisfied to reach interaction or reciprocities between specialized researches, but would locate these connections inside total system without stable borders between the disciplines”. It is an approach that both functions “outside” of disciplines, yet is heavily dependent on them.

The need for a transdisciplinary approach is created by the need to understand the real world, something which is beyond the realm of disciplinary research. It is therefore in this space where disciplines and the real world collide that transdisciplinarity finds itself and it is able to understand and convey the “reality” of the world.

Within the realm of rural development, this multifaceted, holistic, transdisciplinary understanding of reality is essential to the success of such endeavours where complexity and uncertainty reigns. It is in this space, within as well as outside a multitude of disciplines, where social learning, Gallopin's holistic, integrated systems perspective and the subject-driven Sustainable Livelihoods approach are accommodated.

2.3. Renewable Energy and Development

As was stated in the introductory section, energy has an essential role to play in the realisation of the Millennium Development Goals and the overall achievement of development. This fact is echoed by such powerful voices as JoAnne DiSano, director of the United Nations division for Sustainable Development (2002), Dominique Lallement, advisor to the World Bank's Energy and Water department and Manager of the Energy Sector Management Assistance Program (2005), Peter Meier, Chief economist of the International Development and Energy Associates (2005) and Mohan Munasinghe, Chief Energy Advisor to the Government of Sri Lanka (2005).

Complexity theory suggests that "...a small intervention may produce enormous spin-offs, possibly leading to great or horrible consequences most probably unforeseen at the time of intervention" (Cilliers, 2000: 24). It is in the belief that energy is indeed this "small intervention", and that its consequences will be great (instead of horrible), that it is being promoted as an essential component of and pre-requisite for rural development, especially in the light of the enabling capability of rural energy.

With more than half of the world's population currently living in rural areas, rural electrification is and will remain an essential component of rural development (Byrne, 2002). Within this context, substantial barriers create enormous opportunities for the deployment of Renewable Energy in rural environments. These include issues such as the remote location of many rural households, environmental constraints and poverty.

In light of these and numerous other challenges, Asif and Muneer (2007) state that "renewable energy is the solution to the growing energy challenges". Phuangpornpitak and Kumar (2007) are more or less of the same opinion when they state that "photovoltaic hybrid systems can make a positive contribution to the sustainability of rural communities in developing countries that do not have access to the electricity grid". Taelle *et al.* (2007) see the same potential for Renewable Energy in developing countries like Lesotho (2007).

What is clear is that renewable energy is an essential part of rural development. What is not clear is how this is to be achieved. This is especially true when one starts investigating rural renewable energy projects and discover a great amount of what can in all honesty be classified as failures. The reasons for these failures are almost as numerous and diverse as the failures, yet they can be classified according to a few overarching “themes”, as is illustrated by Table 2.1.

Table 2.1: Constraints/Causes of Failure in Rural Renewable Energy Projects

<i>Cause of Failure/ Constraints</i>	<i>Dimension</i>	<i>Project Stage</i>	<i>Energy Type(s)</i>	<i>Country</i>	<i>Author/ Source</i>	<i>Year</i>
Maintenance	Institutional/ Technical	Monitor and Evaluation	PV Biogas	Zimbabwe Botswana	... Mapako and Afrane- Okese, Mapako	... 2006, 2002 ...
Mismatch with needs	Social	Assessment	Biogas	Botswana	Mapako	...
Financing Arrangement	Economic/ Social	Assessment?	Biogas PV	Botswana Zimbabwe	Mapako	...
Durability	Technical	Design	ProBEC clay stoves	Zimbabwe	Mapako	...
Lack of Training	Institutional/ Social	Implementation	Biogas PV	...		
Top Down Implementation and/or design	Institutional/ Technical/ Social	Assessment	PV Wood/Coal Stoves	...		
High Installation Costs	Economic	...	Solar, biomass, wind and small hydro	India	Varun <i>et al.</i>	2007
Social Barriers	Social	Assessment	Wind Power	Netherlands	Agterbosch <i>et al.</i>	2007

Table 2.1 supports the assertion by the World Bank, Mapako and others that an approach that accommodates all spheres needs to be used; no one sphere clearly stands out as a definite “culprit” when it comes to these failures.

Apart from the failures that are mentioned, the literature on development oriented energy and renewable energy also highlights a number of very important lessons that have been learned. These lessons are summarised in Table 2.2.

Table 2.2: Lessons Learned

<i>Lessons Learned</i>	<i>Dimension(s)</i>	<i>Energy Type(s)</i>	<i>Country</i>	<i>Author/Source</i>
Energy Subsidy for poor households not necessary	Economic/ Institutional	Grid	Zambia	Kalumiana
How critical a project component is, depends on the stage	...	Renewable and grid	Southern Africa	Mapako
Public sector: Promote and Assist Private: Disseminate	Institutional	Biogas	Zimbabwe	
Poor user awareness: abuse	Social	PV	Zimbabwe	Mapako
Local maintenance ability essential	Institutional/ Technical/ Social	PV PV water pumping	Zimbabwe	Mapako
Scattered Systems Maintenance Expensive	Economic/ Technical	PV	Zimbabwe	Mapako
Good infrastructure, technical competence, local design and manufacture capability and supportive govt. policy = rapid dissemination	Institutional/ Technical	PV, hybrid, LPG	South Africa	Mapako
Need to lower installation and maintenance costs	Economic/ Technical	PV	South Africa	Mapako
Need to increase robustness of systems	Technical	PV	South Africa	Mapako
Customers need to be represented by an independent body	Institutional/ Social	PV	South Africa	Mapako
Customers need to be better informed (technical and policy issues)	Institutional/ Social	PV	South Africa	Mapako
Local climate can have an impact on acceptability (<i>local knowledge</i>)	Social/ Technical	Improved Woodstoves	Zimbabwe	Mapako
Cultural aspects can have an impact on acceptability	Social	Improved Woodstoves	Zimbabwe	Mapako

<i>(local knowledge)</i>				
Effective Institutional Arrangements NB	Institutional	Micro-hydro PV PV water pumping Gasification Wind Pumps GENSETS	...	
Multi-Stakeholder approach NB	Institutional/ Social	PV water pumping		
Guaranteed Maintenance NB	Technical/ Institutional	PV water pumping Gasification Wind Pumps GENSETS		
Suitable Financing NB	Economic	Gasification PV PV water pumping Wind Pumps GENSETS		
Energy Supply to Rural Poor is not merely choosing the right technology	All	Cherni <i>et al.</i>
Trust NB for technology transfer	Social/ Institutional	Murphy

There seems to be a correspondence between the failures associated with the rural energy projects and the lessons learned, hopefully indicating that the failures have not been in vain and will not be replicated. The practical product of such a learning experience is bound to be a framework or decision-making model of some sort that will enable sustainable decision-making for rural renewable energy. This correspondence also extends to the multidimensional definition of rural development given by Singh; accordingly, the integration of renewable energy into the rural development paradigm is of great importance to the sustainability of the technology transfer in particular and sustained development in rural settings in general.

The briefly mentioned “rural energy implementation framework” should therefore not only be based on the lessons learned from the failures of previous rural energy projects, but should also incorporate the current theories found within rural development thinking.

2.4 Decision-making models

The “Energy for Sustainable Rural Livelihoods” manual that was recently published by the Intermediate Technology Development Group (ITDG) is such a framework (Mulugetta *et al.*, 2005). As the product of practical experience in technology related development, the manual serves in pragmatically integrating all spheres of the rural developmental process in a very flexible, “people”-based manner. As such, the social and institutional spheres receive a great deal of attention, not for a moment relegating it to anything less than the technological, ecological and economic spheres.

The social sphere primarily focuses on using participatory techniques to gain indigenous knowledge as well as determine possible impacts of technology choices. It also places people and their needs in the centre of the rural renewable energy process. The institutional sphere is mainly concerned with the creation of supportive institutions. This is not restricted to any level of government or organisation, but is a cross-cutting call for meaningful institutional transformation in the face of the need for rural energy.

Environmental considerations, closely linked to the institutional sphere in terms of indigenous knowledge and participatory environmental management, are regarded as equally important in comparison to other considerations given the goal of sustainable development. Economic issues are definitely not left in the background; instead, it is asserted that economic considerations are indispensable for the sustainability of any such project. The choice of technology is a product of the careful assessment of demand and supply, skills (required and available) and the standards and quality control measures in place.

Cherni *et al.* (2007) have derived the second framework, a multi-criteria decision support system that makes use of a large amount of technical and non-technical information collected in a variety of ways to determine the most appropriate energy choice. The software used by the Sustainable Rural Energy Decision Support System (SUREDSS) was developed by the Renewable Energy for Sustainable Rural Livelihoods (RESURL) project which is funded by the UK Department for International Development (DFID). SURE was tested in a remote Colombian

rural community, who were already making use of a diesel generator but required additional energy.

Both the ITDG manual and the SURE decision support system will be more thoroughly described, assessed and partially combined in the following chapter.

In conclusion, the realm of rural development is home to complexity and all of its associates rendering “simple”, one-dimensional solutions useless. This is especially true for energy and requires one to properly analyse and integrate all sectors of the rural “landscape” if one aims to deliver energy solutions that are sustainable. This realisation seems to have led to the creation of both the ITDG manual as well as the SURE decision support system, equally focusing strongly on wide-ranging analysis as well the eventual end-users.

Chapter 3: Anatomy and Integration of the Frameworks

3.1. Introduction

This chapter has as its purpose the explanation of the ITDG manual as well as the SURE decision support system, both in isolation of each other but even more importantly also in their complementary, integrated format. For this reason, the discussion of the proposed frameworks for rural energy provision needs to first address the characteristics, similarities and differences between the two frameworks, after which they will be combined into one framework. The flowcharts of Figures 3.1 and 3.2 are useful as basis for this discussion.

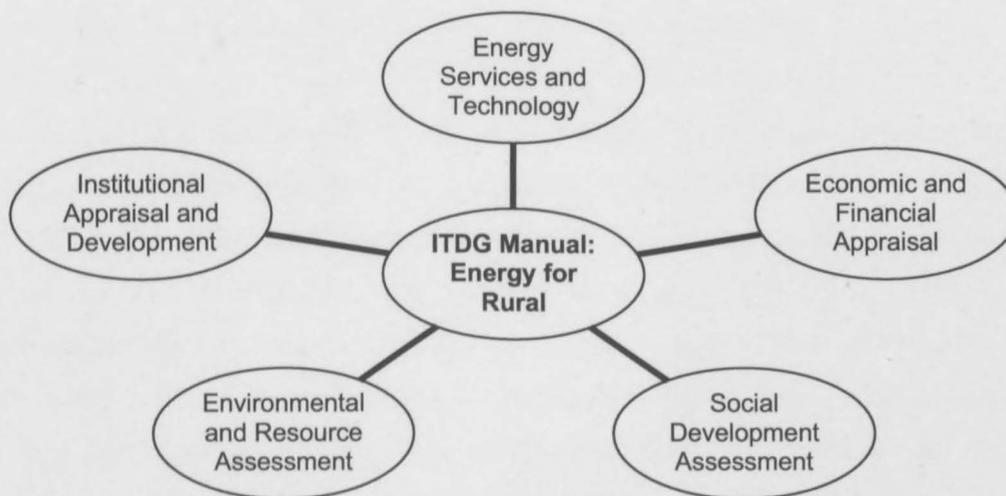


Figure 3.1: The ITDG manual framework

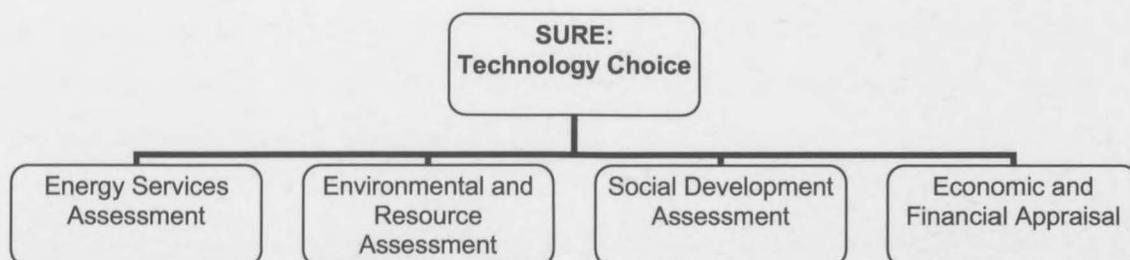


Figure 3.2: The SURE decision support system framework

The assessment methods used by the ITDG manual as well as the SURE tool do not differ significantly. However, there are two important differences between the approaches, which are made clear by the two diagrams. The first is that all of the assessments of the SURE “method” feeds into a computer model that eventually comes up with an appropriate technology choice, in other words a hierarchy is established with technology occupying the top position when it comes to sustainable energy provision for rural communities.

Instead of moving towards a more sustainable path of evaluation and implementation, the path propagates only one intervention for energy development in this rural context, which is totally technology dependant, even though this technology choice is informed by almost all the other dimensions. The problematic assumption that accompanies this kind of thinking is that the complexity of the rural energy sector can be resolved through a “well-informed” technology fix, instead of the old-fashioned “ignorant” technology fix; this assumption automatically maintains the idea that sustainable rural energy provision is about providing the right technology fix, whereas the ITDG manual acknowledges that it is a complex process that requires much more than a once-off best-choice technology.

This however brings about the second important difference. Whereas the ITDG manual has a whole section/chapter devoted to institutional assessment and development, this is noticeably absent from the SURE system of assessment. Not only does this reveal an essential gap in the SURE system, it also highlights an important distinction between the two systems; SURE is concerned solely with the once-off choice of technology, in the belief that the appropriate technology choice will result in a sustainable energy situation. Whereas there may be some truth in this assumption, the more important reality that the ITDG manual takes cognizance of is that

the context, which includes the needs and resources, is dynamic. This constant change is what might undermine the sustainability of the technology choice produced by SURE, since it may not necessarily allow for such change, or uncertainty.

The ITDG manual partly addresses this problem by focusing on the development of, for example, institutions in addition to their assessment. What their experience has taught them is that rural energy is not just about technology choice, but also about development.

In essence, it is about the balance between a choice and a strategy, where the former is the result of the SURE decision support system and the latter the result of the ITDG manual.

Although the SURE decision support system does not provide an appropriate “strategy” for the implementation of rural energy technology, it does enhance the chances of success of the strategy produced by the ITDG manual. This is achieved by promoting the technology that is sure to be the best option for the community concerned. The rest of the strategy surrounding this technology can now be developed (in partnership with the community) around this technology.

How does one reconcile these two different approaches? By integrating the SURE tool in the ITDG manual in the way illustrated in Figure 3.3.

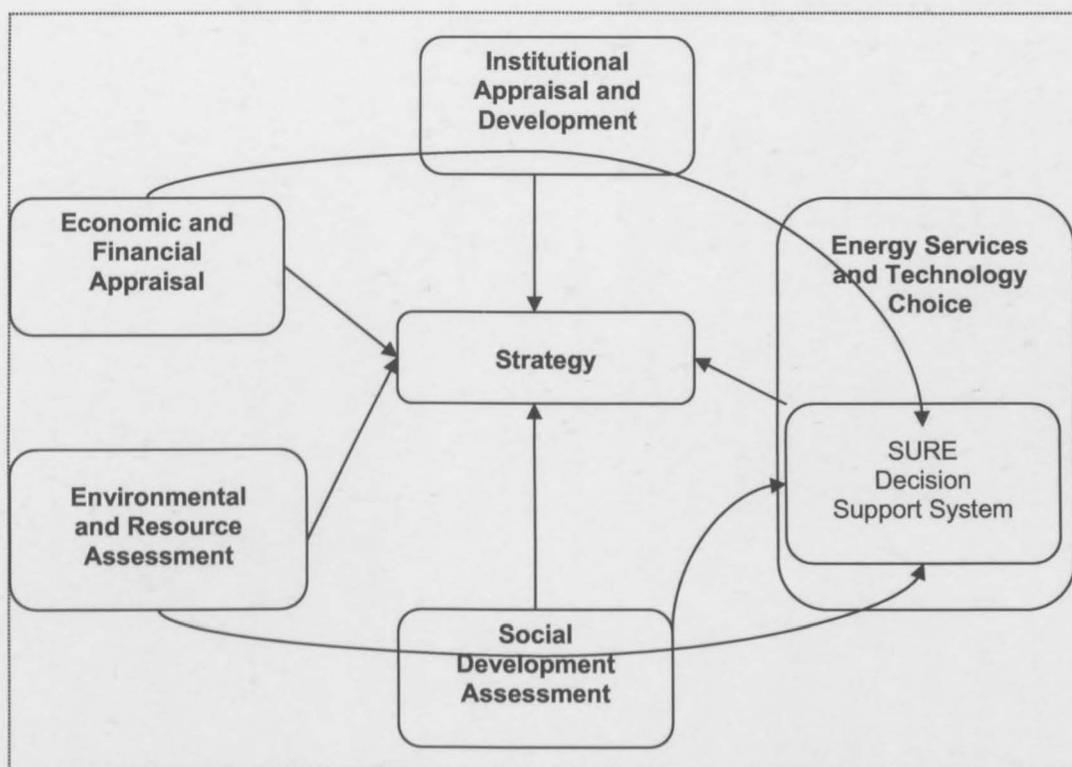
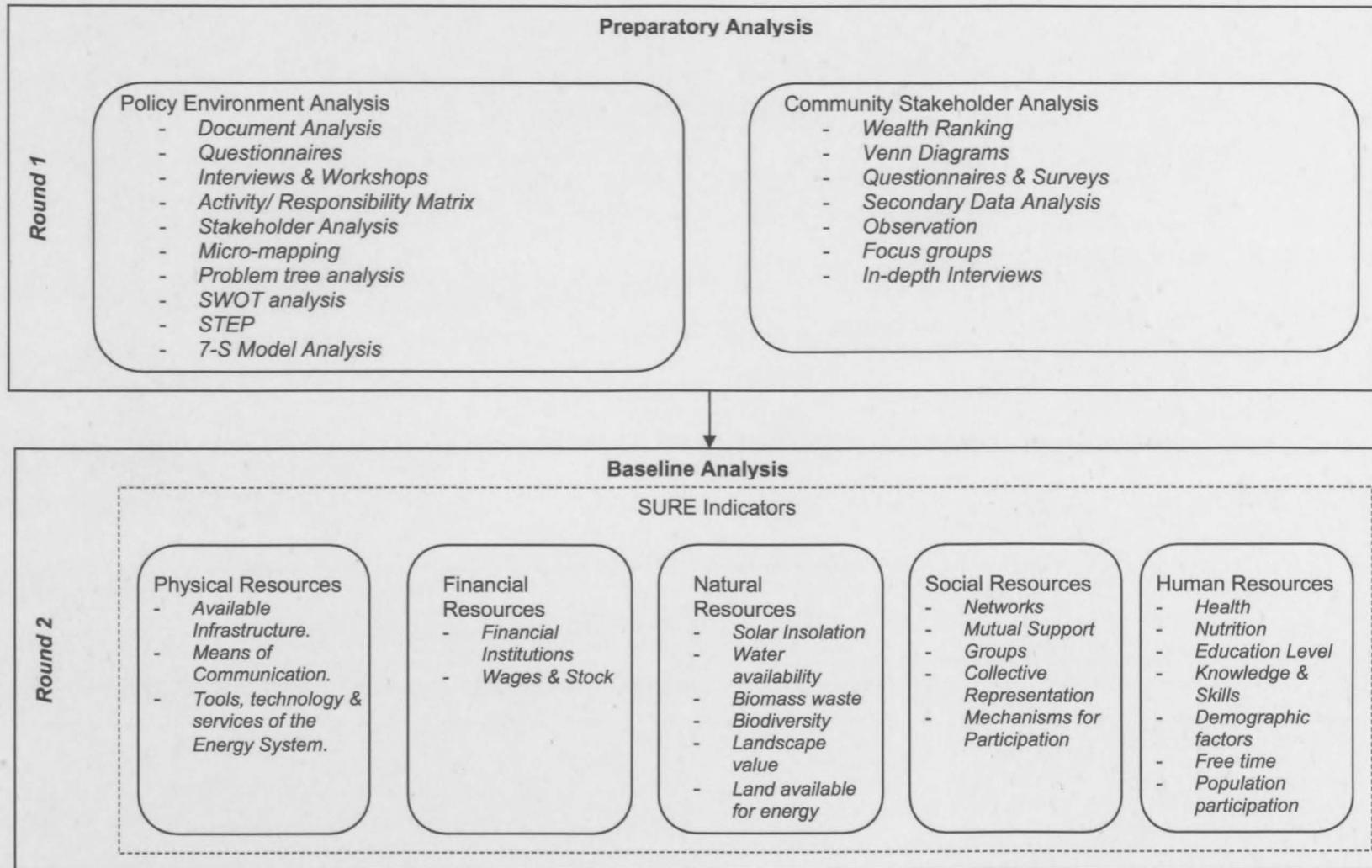
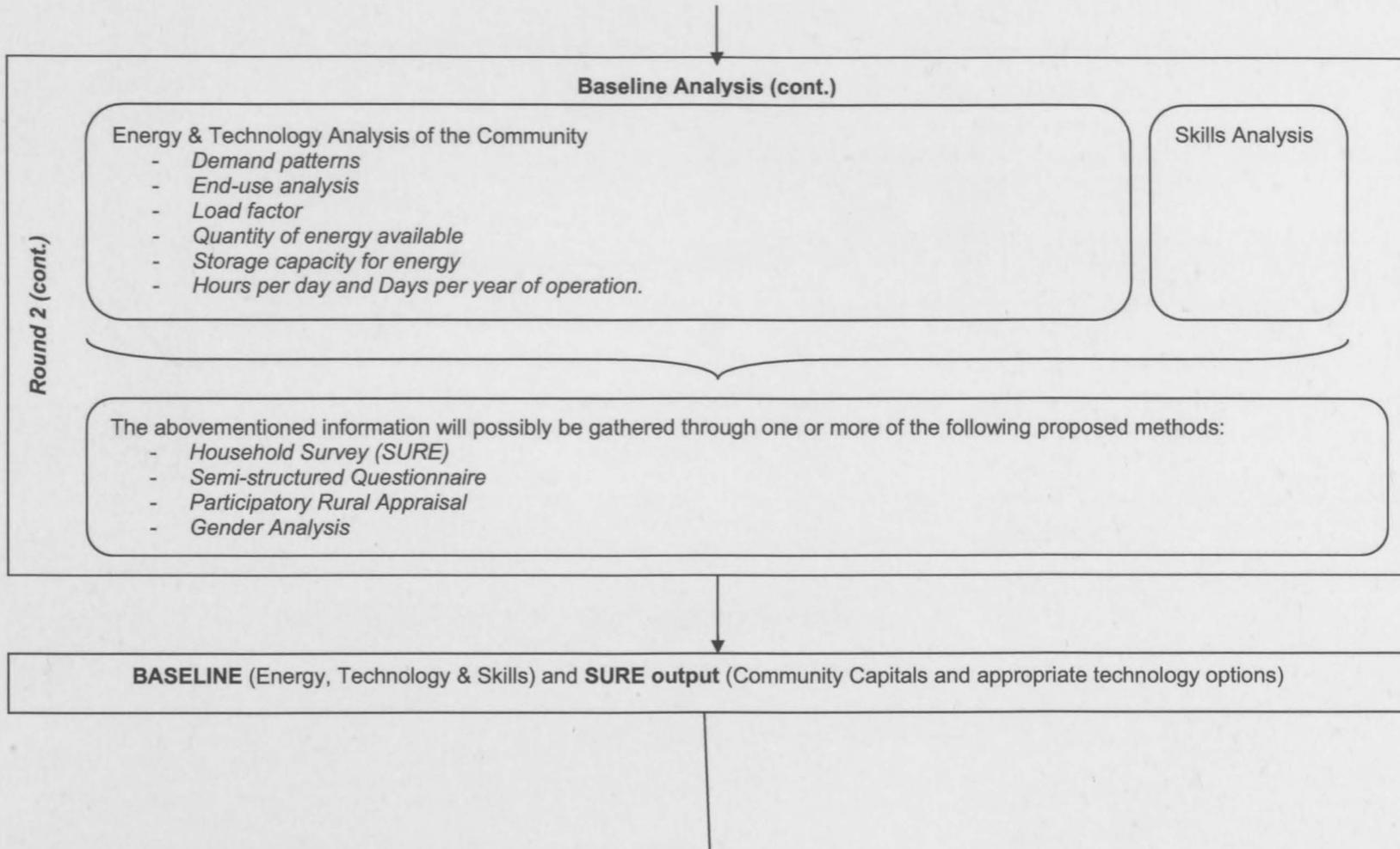


Figure 3.3: The proposed ITDG-SURE-DSS "combination" framework

Figure 3.3 makes it clear that the two approaches are very complimentary, even though they have different objectives: the SURE decision support system is focused on delivering a once-off, relatively short-term advisory "decision", or optimal option. The ITDG manual, on the other hand, is focused on coming up with a strategy that is suited to the specific context. As such, the decision-support provided by SURE greatly enhances the efficiency of the ITDG manual by providing a more robust technology choice system yet without undermining the other four spheres in terms of their contribution to the strategy.

The functional detail of the two systems will be discussed in the broad framework of the different stages of a project, allowing for an increased understanding of the interaction between these two.





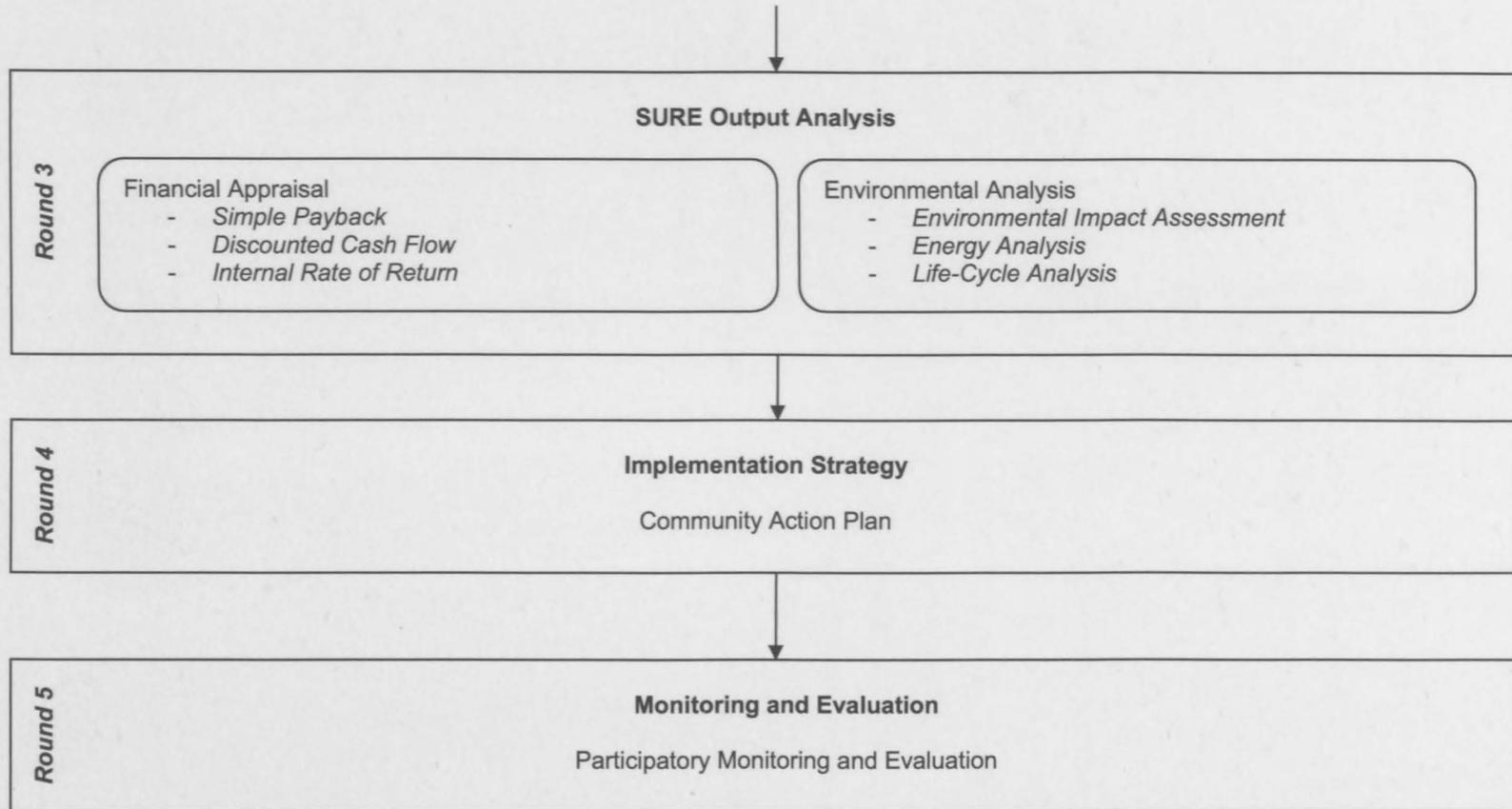


Figure 3.4: Round-by-round breakdown of the proposed framework

3.2. Stage-breakdown of the proposed framework

3.2.1. Stage 1: Preparatory Analysis

Two areas in need of preparatory analysis are identified by the authors of the ITDG manual: the policy environment, and the community stakeholders.

3.2.1.1. Policy Environment Analysis

“The Policy Environment represents the broad context within which development processes take place...” (Mulugetta *et al.*, 2005: 100) and can be either an enabling or a constraining factor. “An understanding of the policy environment would yield information on the impact of policies on livelihoods and help in defining appropriate policy options” (Pasteur, 2001). A Policy Environment Analysis allows one to gather and critically analyse information on the policies relevant to the proposed project.

Table 3.1 proposes methods for gathering the needed information for a Policy Environment Analysis.

Table 3.1: Information gathering methods: Policy Environment Analysis

Information gathering method	Functional summary
Document analysis	<i>Government policy documents, ministerial directives, memos, draft papers, statements from key decision makers.</i>
Questionnaires	<i>To gain a broad picture of people's views on policy matters.</i>
Interviews and Workshops	<i>When details of the policy context and processes, and their impact on the ground are not clear, interviews and workshops can be conducted with key informants.</i>
Activity/Responsibility Matrix	<i>Institutional responsibility assessment represented in diagrammatic form.</i>
Stakeholder analysis	<i>Identify and assess the importance and interests of key people, groups or institutions that have an impact on policy or are influenced by policy.</i>
Micro-mapping	<i>Evaluates intra-sectoral support for new policies and ideas.</i>
Problem tree analysis	<i>Illustrates the linkages between a set of complex issues relationships by fitting them into a hierarchy of related factors.</i>
SWOT Analysis	<i>Used to identify Strengths, Weaknesses, Opportunities and Threats in relation to the strategic planning of an organisation or a particular reform option.</i>
STEP	<i>Social, Technological, Economic, Political) Analysis (used to scan the external macro-environment in which an organisation operates and complements SWOT analysis.</i>
7-S model Analysis	<i>Shared values, strategy, structure, systems, skills, style and staff are key mutually dependent organisational variables that need to be taken into consideration in effecting organisational change.</i>

(Mulugetta *et al.*, 2005: 100 - 119)

3.2.1.2. Community Stakeholder Analysis

A stakeholder analysis can be used to identify individuals, groups, communities or institutions that are likely to be affected by, or can have an influence on, the outcome of a project or programme (ODA, 1995). A community stakeholder analysis is focused specifically on the community affected by the energy project.

Steps involved in a community stakeholder analysis:

1. Identify the main stakeholders;
2. Assess stakeholder interest and impact of the project;
3. Determine stakeholder influence and importance; and
4. Outline a stakeholder participation strategy.

Table 3.2: Information gathering methods: Community Stakeholder Analysis

Information gathering method	Functional Summary
Wealth Ranking	<i>Assigning households to well-being categories.</i>
Venn Diagrams	<i>Diagrammatic representation of key institutional interactions.</i>
Questionnaires & Surveys	<i>Can be qualitative or quantitative and makes use of sampling techniques.</i>
Secondary Data Analysis	<i>Reorganising a piece of previously collected information in order to answer a research question.</i>
Observation	<i>Taking part or being detached, it involves watching what people do, from which one gains certain information.</i>
Focus Groups	<i>Interviews with a small group of relatively homogenous people.</i>
In-depth Interviews	<i>Involves asking questions, listening, writing down and affording respondents the opportunity to respond to open-ended questions.</i>

(Mulugetta *et al.*, 2005: 29 – 35)

3.2.2. Stage 2: Baseline Analysis

A baseline analysis simply involves describing and quantifying in detail the physical, biological, social and economic conditions in the area that may be affected due to the project, and serves primarily as a benchmark for the future.

The SURE (Sustainable Rural Energy) decision support system, developed by RESURL (Renewable Energy for Sustainable Rural Livelihoods), makes use of the Sustainable Livelihoods approach as part of its decision support system. As such, SURE needs to first of all be "fed" with information as to the current status of these different capitals. Below follows a brief discussion of the five capitals, as well as the indicators that constitute them (Cherni *et al.*, 2005: 17 - 19).

3.2.2.1. Physical Resources Indicator

This refers to the community's basic infrastructure (Ashley and Carney, 1999; DfID, 2000). More precisely, physical capital refers to producer goods, such as buildings, roads, machinery and electricity that may generate a future flow of output; as all are important for energy development. The formula for the physical resource indicator is:

$$PR = In + Co + TT$$

Where *PR* stands for Physical Resources, *IN* is the available infrastructure in the community, *Co* are the available means of communication and *TT* are the tools, technology and services of the energy system.

3.2.2.2. *Financial Resources Indicator*

The community will require the financial means to purchase the equipment and ensure its maintenance. The financial indicator therefore shows what facilities a population has to obtain funds and what sources of income are available:

$$FER = FI + WS$$

Where *FI* are the financial institutions accessible to the community and *WS* are the wages earned by the community and the stock they have to sell.

3.2.2.3. *Natural Resources Indicator*

This refers to the natural resources that are accessible to households or individuals within their rural context from which resource flows useful for livelihoods can be derived (Carney *et al.*, 1999; DfID, 2000). Natural resources are considered as both a source for energy and for the environmental impact of energy technologies:

$$NR = S = Wa + Wi + Ws + Biod + LV + Le$$

Where *S* is the Solar insolation (a measure of solar radiation energy incident on a surface, measured in kilowatt-hours per square meters), *Wa* is water availability, *Wi* is wind availability, *Ws* is biomass waste, *Biod* is the biodiversity, *LV* is the landscape value and *Le* is the land available for energy production.

3.2.2.4. *Social Resources Indicator*

Social assets or social capital refers to community and wider social claims on which individuals and households can draw in the pursuit of livelihoods by virtue of their belonging to different social groups (Ellis, 2000; DfID, 2000). This category of asset is meant to capture the reciprocal relations within communities and between households

based on trust deriving from social ties (Moser, 1998) particularly because these may be affected by the presence or the lack of energy. Political association is a further variable incorporated by RESURL and it exists by virtue of people's affiliation, favouritism or political interests. The social resource indicator is calculated in the following manner:

$$SR = N + Ms + LO + MP$$

Where *N* is networks, *Ms* is mutual support, *G* is groups, *CR* is collective representation and *MR* is mechanisms for participation.

3.2.2.5. Human Resources Indicator

Human Resources refer to the qualities that can be improved, or otherwise, by the provision of energy.

$$HR = H + N + AW + Ed + Ks + D + FT + PP$$

Where *H* is health, *N* is nutrition, *AW* is access to clean water, *Ed* is education level, *Ks* is knowledge and skills, *D* is demographic factors, *FT* is free time and *PP* population participation.

A further analysis proposed by the ITDG manual in order to establish the baseline, is an Energy and Technology analysis. To establish the baseline status of current energy and technology in the community, there are a number of methods that can be used. The methods are described in relative detail in the sub-sections 3.2.2.6. to 3.2.2.9.

3.2.2.6. *Assessment of demand patterns*

In order for the assessment to provide as accurate a reflection as possible of the demand patterns in a community, it is essential that the target community is involved. This also entails involving the poor and marginalised groups in the community. The use of an energy survey is therefore suggested by Mulugetta *et al.* (2005: 10-11) to gather the information needed. The information gathered should enable one to identify times at which energy is required, the quantity of energy required and the future trend of energy demand.

3.2.2.7. *End-use analysis*

End-use analysis involves first of all identifying and prioritising the end-uses of the community. Hereafter, it is important to compile a list of the goods and services those consumers in the community use. This method can only be effectively employed when one knows how much energy is used by different goods and services at all stages of the value chain. Once this information has been gathered, it is possible to develop a strategy that meets these demands with the minimum of required energy and resources.

3.2.2.8. *Load Factor*

Load factor is defined in the Energy Glossary as: “the ratio of average load to peak load during a specific period of time, expressed as a percent. The load factor indicates to what degree energy has been consumed compared to maximum demand or the use of units relative to total system capability. A system's load factor shows the variability in all customers' demands” (Platts, 2007).

The greatest advantage of the load factor is that it enables one to get a clear picture of the efficiencies of the different technologies in terms of their profitability, which provides a good indicator of the financial viability of the system.

3.2.2.9. Energy supply and availability patterns

The supply and availability pattern of a technology is determined by a number of loosely connected technical considerations:

- Quantity of energy available
- Energy storage capacity
- Hours per day and days per year of operation

Additionally, the manual also proposes a skills analysis to determine the level of skills available in the community for the operation and maintenance of the system. To gather all of the information needed to do a proper baseline analysis, there are quite a number of methods proposed by the ITDG and RESURL, summarised in Table 3.2.

Table 3.3: Information gathering methods: Baseline Analysis

Information gathering methods	Functional Summary
Household Survey	<i>This is a standardised survey created by RESURL, with the aim of gathering results on the indicators used in the SURE decision support system.</i>
Semi-structured Questionnaire	<i>This questionnaire is also created by RESURL, with the same aim as the Household Survey. It differs in that it is only used on leaders and stakeholders in the project, with a much more flexible structure..</i>
Participatory Rural Appraisal (PRA)	<i>PRA is a rapid means of carrying out social analysis of "social impact". It draws on an array of participatory oriented traditions whereby local people are not only providers of information, but also determine what the important issues are, the methods employed to get information and participate in the use of the information.</i>
Gender Analysis	<i>Gender Analysis is the range of methods used to understand and document the relationships between men and women, their access to resources, their activities and constraints they face as a function of their sexual category. It can inform the way in which women and men engage in planning, implementation and monitoring of projects.</i>

(Mulugetta *et al.*, 2005: 39 - 47; Cherni *et al.*, 2005: 17)

3.2.3. Stage 3: Analysis and Decision Support

The SURE software processes the information using the Compromise Programming Multi-criteria Method of Yu (1973) and Zeleny (1973). With the information gathered, the SURE-DSS makes use of the following mathematical functions to calculate the appropriate different options:

$$(C_j, j = 1, \dots, 5)$$

$$C_j(A_i) = 1 / (1 + e^{-M_j X_j(A_i)}), \quad (j = 1, \dots, 5; i = 1, \dots, n)$$

Where $C_j(A_i)$ represents the evaluation of the i -th energy alternative (A_i , $i=1, \dots, n$) against the resource j , $j=1, 2, \dots, 5$, (1 indicates Natural, 2 Physical, 3 Social, 4 Human and 5 Financial); $X_j(A_i)$ represents the effects of the i -th energy alternative on the corresponding community's resource j ; and M_j is a scale parameter, associated to the number of factors that compose each resource j .

$$M_j = (20 * (X_j - a) / (b - a)) - 10$$

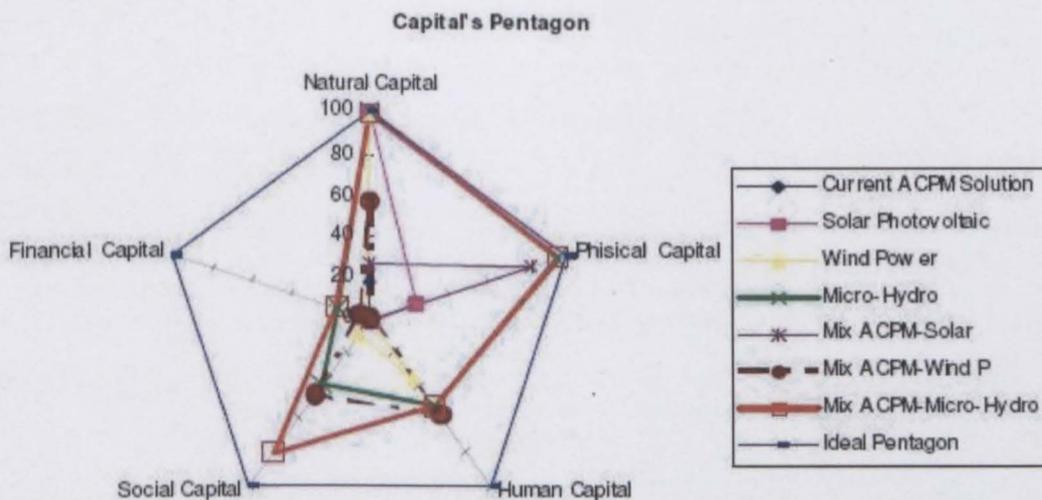
Where a is the lower limit of the X_j range of values; and b is the upper limit of the X_j range of values.

The result of this analysis is a graphical depiction of the different options in the form of a pentagon, based on the 5 capitals used in the Sustainable Livelihoods approach. This pentagon's outer limits depict the ideal state of the community. The pentagon also shows the baseline of the community (before) as well as the effect that the different energy technologies are projected to have (after).

As the developers of SURE put it (Cherni *et al.* 2007: 1496):

“The system allows the decision-maker to assess the effect that new operating energy systems might have on every asset owned by the community. It does so by calculating and comparing the different initial conditions of the assets in a community with values resulting from the implementation of the new energy alternative in relation to an ideal condition of full development of all the resources”.

A main contribution of the system therefore is that it enables quantification, through a numerical index, of the gaps between the theoretical and ideal livelihood; the possible effects on livelihoods of particular energy technologies; the existing condition of the assets and their possible improvement with the application of energy; and finally, the system calculates the trade-offs among alternative livelihoods with different energy solutions. The underlying goal of minimising the gap between the maximum possible value for each asset (a theoretical state) of greatest development and the real value that it could achieve through the application of an energy technology is illustrated.



*Figure 3.5: SURE-decision support system output (Cherni *et al.*, 2007: 1500)*

Apart from this output delivered by SURE, the ITDG manual proposes the use of additional financial appraisal methods to assist the decision-making process. These are summarised in Table 3.3.

Table 3.4: ITDG-proposed financial appraisal methods

Financial Appraisal Method	Functional Summary
Simple Payback	<p>The simple payback time is the period, usually expressed in years, within which the initial investment is completely recovered.</p> $P=C/(b-c)$ <p>Where P is the simple payback time, C the total capital cost of the project, b the projected annual benefits and c the projected annual running costs.</p>
Discounted Cash Flow Analysis (a.k.a. Net Present Value)	Discounted cash flow analysis relies heavily on the principle of discounting future costs and benefits so as to represent them in terms of their present value.
Internal Rate of Return	The internal rate of return (IRR) on project X is defined as the discount rate r at which $NPV(X,r) = 0$.
The Generation Cost (Used by the SURE-DSS)	The generation cost methodology is a further variation of discounted cash flow analysis. This method provides a rather straightforward way of comparing the financial costs of different electricity generating options.

(Mulugetta *et al.*, 2005: 56 – 66; Cherni *et al.*, 2007)

Environmental assessment is also necessary when supporting decision-making with regards to renewable energy. The ITDG manual again proposes a number of methods for conducting this analysis, summarised in the table below.

Table 3.5: ITDG-proposed environmental assessment methods

Environmental Assessment Method	Functional Summary
Environmental Impact Assessment (EIA, also used by the SURE-DSS)	<p>EIA incorporates potential environmental changes due to a particular activity and is a structured approach for identifying, predicting, evaluating and mitigating the potential environmental, social and health effects of a proposed development project to facilitate rational and open decision-making</p> <p>In rural energy projects, the role of EIA is to provide information to stakeholders and other concerned parties about the impact of the project on the environment, both human and natural.</p>
Energy Analysis	Energy Analysis is used to calculate all the energy inputs per unit of output of a product, process or system. It is important for the determining the viability of energy systems from a resource perspective and can also be used to calculate the energy payback time.
Life-Cycle Analysis	Life-cycle analysis goes farther than energy analysis in that it looks at all the impacts (not just energy) of all the components of a product over its lifetime.

(Mulugetta *et al.*, 2005: 73 – 90; Cherni *et al.*, 2007)

3.2.4. Stage 4: Implementation Strategy

It is important to see the Community Action Plan (CAP) as “...a process which enables communities to design, implement and manage their own programme or project” (Mulugetta *et al*, 2005: 47). As such, the creation of the plan takes place during an intensive participatory, community-based, problem-driven workshop. The development plan takes shape through the prioritization of problems and the formulation of strategies and options for dealing with them.

Of pivotal importance for the CAP method, is the creation of partnerships “...between the local people and the project staff in a mutual learning process of dialogue, negotiation and decision-making” (Mulugetta *et al*, 2005: 47 – 48). Stakeholder Analysis or PRA can also be used to enhance the effectiveness of CAP by identifying the main actors as well as the main problems that need to be addressed.

The stages of a CAP process are (Mulugetta *et. al.*, 2005: 47 – 49):

1. Problem identification and prioritizing;
2. Consider alternative courses of action;
3. Identify the tasks and the retrospective actors involved;
4. Identify gaps and weak linkages;
5. Agreement on coordination mechanisms; and
6. Agreement on indicators and monitoring mechanisms.

3.2.5. Stage 5: Participatory Monitoring and Evaluation (PM&E)

The fundamental processes of PM&E are as follows:

- Establish framework;
- Identify indicators to be used;
- Gather the data;
- Analyse; and
- Agree on findings and what to do next.

“Participatory Monitoring and Evaluation goes beyond addressing the conventional management efficiency imperatives to identify and respond to a project’s changing needs by involving multiple stakeholders to decide how progress should be monitored and results acted upon” (Mulugetta *et al*, 2005: 49). What this comes down to is that PM&E is “...a process of self-assessment, knowledge generation, and collective action in which stakeholders in a programme or intervention collaboratively define the evaluation issues, collect and analyse data and take corrective action as a result of what they learn through this process” (Mulugetta *et al*, 2005: 49). Those involved in PM&E usually include the end-users of project goods and services, NGOs and other intermediary organizations, private sector business and government employees from different levels.

PM&E thus revolves around four principles (Mulugetta *et al*, 2005: 50 - 51):

- Participation;
- Negotiation;
- Collective learning; and
- Flexibility.

Table 3.5 provides a summary of the abovementioned methods, analyses and frameworks, allowing one to gain a more thorough understanding of the eventual product or integrated framework that is being proposed for further evaluation. As may be observed, a major part of this overall framework revolves around analysis, allowing for the proper assessment of all major areas of the rural community. Much of this analysis is reliant on the communities themselves and requires their continued involvement since the analysis methods are technologically neutral and aims to deliver a solution that is acceptable to the community. The implementation and monitoring and evaluation stages are also created in such a way that they are community led and –motivated, which not only has sustainable technology implementation but also empowerment in mind.

Table 3.6: Framework Summary

Project Section	Proposed Methods
<i>Preparatory Analysis</i>	Policy Environment Analysis
	Community Stakeholder Analysis
<i>Baseline Analysis</i>	SURE: <i>Physical Resources</i>
	<i>Financial Resources</i>
	<i>Natural Resources</i>
	<i>Social Resources</i>
	<i>Human Resources</i>
	Energy and Technology Analysis
	Skills Analysis
<i>Implementation</i>	Community Action Plan
<i>Monitoring and Evaluation</i>	Participatory Monitoring and Evaluation

Chapter 4: Research Design and Methodology

4.1. Background

The problem of implementing rural renewable energy in South Africa needs to be addressed in a pragmatic way that is able to deal with the complex reality of such implementation. Finding a framework suited to this complex reality therefore requires investigation into what will constitute such a suitable framework. The literature review identified possible appropriate frameworks, which were combined into a single proposed framework. This research methodology chapter subsequently deals with how the proposed framework was evaluated.

In order to approach the evaluation adequately, the following question needs to be addressed first: “what are the underlying philosophical assumptions that will determine our judgment?”. Therefore, an overview is first provided of some of the most pervasive philosophies that affect scientific inquiry as we know it today. Next, the rationale is discussed for the choice of research design and methodology, addressing rather broad theoretical considerations associated with the Delphi method, which is the most appropriate research method identified by the initial overview for the testing of the frameworks. Lastly, a description of the actual research process that was followed is provided.

4.2. Research Philosophy

Although much has been written on the Delphi technique, there is still a great amount of uncertainty surrounding it and its intellectual roots. According to Linstone and Turoff (2002), the Delphi technique, due to its relatively “young” nature as a research method, has multiple philosophical roots that enable us to make sense of it. Four distinct schools of thought are identified that have a very distinguishable effect on the technique in terms of its functioning and overall epistemology.

4.2.1. *Locke*

The metaphorical “father” of the Delphi technique in terms of distinguishable philosophical roots is definitely Locke, representing empiricism at its most evident. The truth proposition of the Lockean perspective rests solely on experience: whatever is empirically verifiable is true. Whatever can not be verified in this manner is not true. A logical consequence of this proposition is that theory exists totally independent of observation, yet it can only be formulated as a product of that which has already been observed. As such, theory is totally dependent on observation and does not contribute to the truth content of observation.

The fact that the Delphi technique is the product of trust in the opinions of experts, i.e. those with relative experience, to determine the “truth” in different situations where adequate alternative information is not available, is an excellent example of the strength of Lockean foundations of the technique; in fact, the Delphi technique is viewed as the pinnacle of the Lockean system of inquiry (Linstone & Turoff, 2002: 20).

4.2.2. *Leibniz*

Truth is a priori, i.e. it precedes experience and is a consequence of logic. Experience cannot be trusted. That which cannot be logically stated cannot be held to be true.

These are some of the foundational statements that constitute the Leibnizian philosophical perspective and stands in almost direct contrast with Locke’s empiricism. The two perspectives of Locke and Leibniz are joined in their assertion that theory and observation are fundamentally separate entities. The fundamental difference is however a function of the position afforded to a priori knowledge, in that theoretical propositions are viewed as the foundations of knowledge. This is the perspective that has had the greatest impact on science as we know it today in its analytical format.

The Delphi technique is often criticised at the hand of the Leibnizian perspective and accused of being “unscientific”, in as far as science is equated with this perspective. Although these criticisms have greatly improved the robustness of the Delphi technique, the mystery of decision-making and human thought processes in general still eludes us and it is therefore as yet impossible to create appropriate theories for these phenomena.

4.2.3. *Kant*

Kant’s truth proposition holds that all truth is synthetic. For this reason, the theoretical and observational facets of “reality” are inseparable. Every theoretical proposition needs to have an empirical referent, and vice versa. The synthetic nature of truth proposed by this perspective implies that objectivity is fundamentally called into question, bringing about the need for multiple perspectives to gather as much subjective “evidence” as possible that all contribute towards forming a possible appropriate picture of reality.

The Kantian Delphi is not the consensus oriented exercise proposed by the Lockean perspective, but rather the policy Delphi, where as many perspectives as possible can be gathered from multiple fields and frames of reference in order to provide decision-makers with a myriad of substantial options.

4.2.4. *Singerian-Churchmanian*

According to Linstone and Turoff (2002), this is the philosophical perspective most difficult to explain. However, it is primarily premised on the fact that truth is pragmatic; a holistic frame of reference is therefore required since no part of a system has significance over another. The goals or objectives of a system determine what will constitute truth in that system.

As such, a Delphi study that draws from this perspective will derive its value or success from the goals achieved and also shares the approach of the Kantian Delphi in that multiple perspectives are required to present the most holistic picture of reality.

4.3. Rationale and Specific aims

As stated before: the Delphi technique derives fundamental principles from all of these perspectives in one form or another. Different Delphi's feed more from different perspectives, depending on the goals identified for the study. The technique is still in such relative infancy that there is much room for increased differentiation and specialisation within the technique and currently affords it much flexibility.

As the aim of the study is to test the applicability of established rural renewable energy implementation frameworks in South Africa, it requires either the use of multiple case studies or an expert-based group method. Multiple case studies require a large amount of resources, especially time, since very little applicable information is available on rural renewable energy projects in South Africa. Even then, the input of experts directly involved with the projects is bound to carry an enormous amount of weight in the case study.

The temptation to dismiss the use of case studies as a research method based on its perceived lack of generalisability is also quite strong, since the perception exists that the in-depth nature of research common to case studies hampers its wider applicability (Tellis, 1997). However, Flyvberg (2006) clearly demonstrates that not only can one in many cases generalise based on a single case, but also that "...formal generalisation is overvalued as a source of scientific development, whereas the 'force of example' is underestimated." Nevertheless, two important conditions need to be stated: generalisability from a single case is highly dependent on the type of case that is being used.

This particular study calls specifically for a certain degree of generalisability and context independence, even though one of the main aims of the study is to determine whether the framework is appropriate for the particular South African context. Also, the use of multiple experts who, according to Flyvberg, is someone who has intimate knowledge of a very large number of cases, allows one to make use of a large number of cases at once

and establish the appropriateness of the framework across all of these specific cases. The “force of example” is present in multiple forms in each expert, allowing him or her to use that force to, in this case, test the proposed framework in each of the contexts. This may not produce a context-independent appropriateness test, but it may very well produce a test appropriate across a large number of contexts.

Hasson (2000) recommends that when there is insufficient information on a subject, a consensus method, brainstorming, nominal group technique or Delphi study can be used. This is echoed by Delbecq (1975), who also recommends either the Delphi technique or nominal group technique to arrive at conclusions that are not sufficiently valid in individual format yet where individual judgments are required, i.e. where there is the need for verification by multiple sources.

Whereas in the Delphi technique there is no direct interaction of participants, the nominal group technique makes use of group interaction, but only after members have individually recorded their ideas on paper. These ideas are recorded and presented to the rest of the group. There is a strong correlation between the nominal group technique and the Delphi technique since written information by individual group members is also shared with the rest of the group when one uses the Delphi. The anonymity of the respondents in terms of their connection to the responses is also an area of overlap.

However, the Delphi technique is much more structured since group members remain completely anonymous to each other and all discussion and/or feedback takes place through the researcher. Several descriptive definitions exist for the Delphi technique: it is regarded as a structured group technique that is conducive to complex problem solving (Linstone and Turoff, 2002: 3); aggregated expert judgments to improve decision-making is the purpose of Delphi, according to Delbecq (1975: 83). The Delphi technique makes use of two or more rounds of questionnaires or surveys that are sent out individually to group members (Crichton and Gladstone, 1998). Consensus or priority is mathematically derived and the recommended size for a Delphi group is between seven and twenty members (Okoli and Pawlowski, 2004: 19). None of the above “definitions” has any

exclusive right on an accurate reflection of the Delphi since all of them cover an aspect of the technique; without any of these, something of great importance would surely be missing from the method.

In a comparative analysis between interacting group techniques, nominal group techniques and Delphi techniques, Delbecq (1975) found that the nominal group technique and Delphi studies deliver the best results in terms of normative behaviour, equality of participation, methods of conflict resolution and decision closure. This is also the case with regards to the relative quantity of ideas produced as well as the quality and specificity of these ideas.

The Delphi technique is the clear winner when it comes to the participant cost and participant working hours since both of these categories are very low, relative to the other two techniques. The administrative effort required is the highest of all group techniques, as is the calendar time, yet this does not have an adverse effect on participant motivation since it is the researcher's main responsibility. Even then, the researcher may most probably be much better off since the search for willing participants may in fact take a longer amount of time than the amount of hours that the researcher may have to devote to the administration of the questionnaires.

Further advantages of the Delphi technique are numerous:

- It is an enabling research technique where researchers are not geographically co-located and the expenses and practicality of bringing them together is not feasible (Crichton and Gladstone, 1998).
- Respondents do not react to each others' views and therefore exhibit proactive search behaviour. This isolated idea generation process produces ideas of a very high quality (Delbecq, 1975).

- Respondents are able to fit the study into their schedules due to the fact that it is written. They can therefore do it whenever they have the time (Gibson and Miller, 1990).
- Anonymity guarantees individual responses representative of the respondents themselves and not necessarily of the organisations they form part of (Crichter and Gladstone, 1998).
- Conformity, peer pressure, inhibition and intimidation do not affect the participants due to the fact that they are not known to each other and do not directly interact. This allows for honest responses to be generated (Delbecq, 1975; Crichter and Gladstone, 1998; Gibson and Miller, 1990; Moiscovice *et al*, 1998 as cited in Mullen, 2003).
- The group learning effect is not lost due to the fact that participants are fed back the responses of all members of the group (Gibson and Miller, 1998).
- Participants can easily change their responses, especially in the light of other expert responses, without being publicly exposed. It is thus easier to reach consensus since no one feels publicly bound to his or her opinion (Gibson and Miller, 1990; Rudy, 1996 as cited in Mullen, 2003; Crichter and Gladstone, 1998: 437)

However, the lack of social-emotional rewards which is so characteristic of group problem-solving techniques is definitely absent from Delphi studies, as is the opportunity for verbal clarification. The fact that conflict resolution takes place through majority rule also means that conflicts are not necessarily resolved (Delbecq, 1975). A “side-effect” of the anonymity afforded to respondents is that there is no accountability, opening up the technique to manipulation (Sackman, 1974).

Gibson and Miller (1990: 41), in response to a large amount of criticism against in particular the quantitative Delphi technique, state that the most important criterion to determine the success of Delphi study should be usefulness, linking with the Singerian-Churchmanian roots of the technique. According to them, the usefulness therefore lies in the fact that areas of agreement and great disagreement can be identified and new ideas and solutions can be brought to the light.

According to Delbecq (1975: 84), the most important factors for determining the success of a Delphi study are sufficient time, proper writing skills and high motivation of participants. Linstone and Turoff (2002) also add the following 8 pitfalls to beware of when conducting a Delphi:

1. Discounting the future: this is relevant for predictive Delphi's and refers specifically to peoples' urge to discount occurrences that are far removed from the present.
2. Prediction urge: this urge usually manifests when the researcher reports on the results of a Delphi and wants to suppress uncertainty.
3. Simplification urge: this is the result of reducing the complexities of social systems in the interests of analysis
4. Illusionary expertise: the fact that a person is a specialist does not make him/her an expert on the whole system. It is therefore important to assume that responses will still be biased.
5. Sloppy execution: this may be a problem on both the analyst's and respondents' sides, the result of impatience or just poor planning.
6. Optimism vs. Pessimism bias: respondents are inclined to have either an optimistic or pessimistic bias.

7. Overselling: this simply refers to too many Delphi studies on the same application.
8. Deception: manipulation of the Delphi study can be a result of the anonymity of respondents, as was mentioned before.

Some of the abovementioned pitfalls can be negated through the use of multiple rounds of questionnaires, one of the distinctive characteristics of the Delphi technique. However, some of the pitfalls are not affected by the use of multiple rounds and may even be strengthened by them. It is therefore important to be aware of these pitfalls when one analyses results and try to build in possible “defences” against them when one draws up the questionnaires to be used in the study.

4.4. Definition of expert

Since the Delphi technique in many cases rely heavily on the use of experts, it is important to determine what constitutes an expert. Pill (1971, cited in Mullen, 2003) is of the opinion that an expert is anyone who has relevant knowledge of the topic being studied, a position that also enjoys the support of Cantrill (1996). Alberts (2007), however, in a sense narrows down this definition when he states that prior experience with the issue is critical for the success of the study. This is confirmed by his finding that those participants with prior experience could and wanted to greatly contribute to the process. This expert definition, so greatly enamoured with the idea of experience, is a logical result of the strong empiricist roots of the technique and is a testimony of the strong distrust that Locke and his counterparts had for any knowledge that is not experientially derived.

4.4.1. Sampling of experts

Goodman (1987, cited in Mullen, 2003) states that the Delphi was originally conceived as a method that would make use of experts, and not just a random sample of panellists. Helmer (1977, cited in Mullen, 2003) confirms this viewpoint when he states that a Delphi study is not an opinion tool, but rather a specific method of communication between experts. It therefore does not need to reflect the views of a broader population, but instead should assist experts to individually and collectively form responses to the problems at hand. This focused pooling of expert knowledge provides robustness to the results of a study that is far greater than when these results would have been obtained from a “representative” population sample.

4.5. Delphi Design

A Delphi study should have a rock-solid foundation, but also allow participants some room for spontaneous contributions (Crichton and Gladstone, 1998: 434). This implies the use of both closed and open-ended questions and room for response throughout the questionnaires. Thereby participants are allowed to retain a common focus while engaging critically with the questions at hand as well as with each other.

The number of rounds to be used is another key feature of Delphi studies and much discussion in the literature is centred on this. It seems that the number of rounds used have significantly decreased from the time of the first Delphi studies. Sumsion (1998, cited in Mullen, 2003) found that the classic Delphi made use of four rounds, but that the current consensus in the literature is that two or three rounds are sufficient. This decrease in the number of rounds required is most probably a product of the fact that consensus is no longer considered to be the factor that determines when a Delphi should be ended. Rather, the stability of the respondents' vote curve should play this role (Scheibe *et al*, cited in Mullen, 2003). Another contributory factor is that participant interest greatly decreases after three rounds; therefore it is proposed that a Delphi design does not exceed this number (Gibson and Miller, 1990).

4.6. Description of the research process

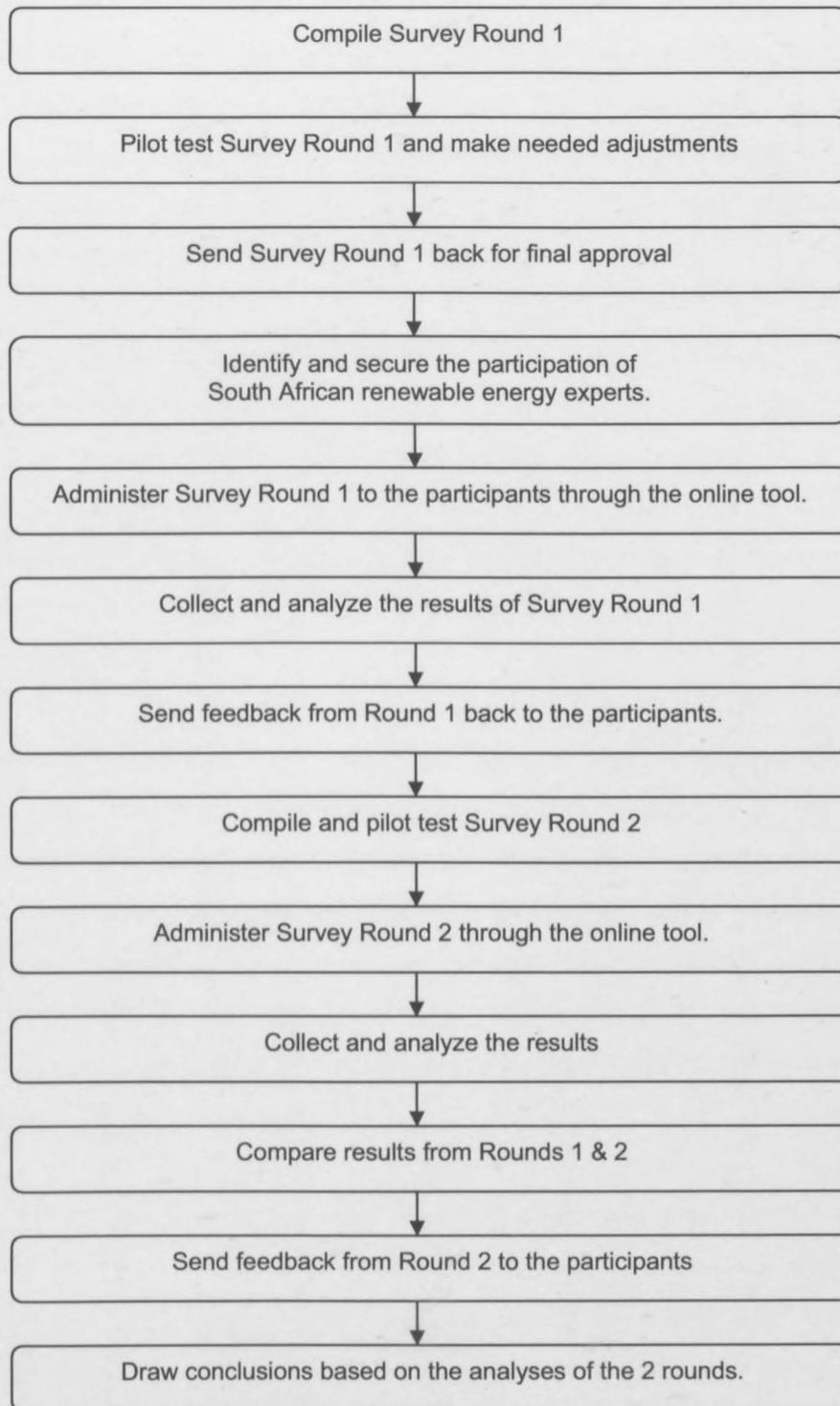


Figure 4.1: The Research Process

4.6.1. Introduction

The nature of the research problem is such that it calls for a research technique that delivers results that are quite generalisable. As was alluded to earlier in the chapter, this requirement automatically disqualifies the case study approach, even though this method allows for a very intense in-depth analysis of a particular case. Mainly for this requirement of generalisability, the Delphi technique was selected.

The Delphi technique is also particularly well suited to situations where those with the expert knowledge on the particular problem are geographically quite scattered and hard to reach, as is the current case with rural renewable energy experts in South Africa. Additionally, the relatively low cost to and effort required from participants ensures that these professionals will be much more inclined to share their experiential knowledge.

4.6.2. First questionnaire

The Delphi study consisted of two rounds: the first round tested the frameworks making use of an online survey tool: SurveyMonkey (www.surveymonkey.com). The choice of an online tool was motivated in large part by the fact that it significantly lowers the administration cost for the researcher since it enables instant access to results, it is very interactive in nature, it allows for quite a significant reduction in response time (which can be an issue with Delphi studies), results are easily modified and analysed and the fact that it makes use of respondents' IP addresses means that there is increased security for respondents.

Multiple choice questions were mostly employed, coupled with explanatory spaces that allowed for respondents to comment or add anything they felt to be of imperative value. Mostly these questions required a graded Yes/No response, or the selection of a number of indicators, methods and the like. Respondents were also expected to justify the majority of their choices in the comment boxes provided.

The first round questionnaire was pilot-tested by three individuals at the South African Council for Scientific and Industrial Research (CSIR) that are highly qualified in the field of renewable energy and research in general. The feedback from this pilot study was used to modify the questionnaire, after which it was sent back to for final approval. Upon approval, possible participatory candidates were contacted via e-mail and telephone and 7 candidates agreed to participate. The overall response rate for the survey was about 7,7%.

E-mails with a URL link to the questionnaire was then sent to the participants, along with background documents providing important information on the context and nature of the study. Also included in the e-mail was a request to complete the survey by a certain date and time.

The first page of the questionnaire supplied a quick introduction to the study in general as well as the survey in particular (see Appendix C). This page also secured the participants' agreement to participate in the study as well as set out the privacy guidelines that will be used. The second page was used to gather demographic information of the participants, establishing them as experts in the field of rural renewable energy in South Africa.

2. DEMOGRAPHIC INFORMATION

PLEASE FILL IN YOUR NAME AND SURNAME. YOU ARE WELCOME TO SKIP THE ADDITIONAL DEMOGRAPHIC QUESTIONS.

1. You will remain anonymous to the other members of the delphi-group. However, your identity will be known to the researcher.

Name:

Company:

Address:

Address 2:

City/Town:

State/Province:

ZIP/Postal Code:

Country:

2. E-mail address:

3. What is your highest qualification?

Figure 4.2: Screenshot 1 of Survey

From there on, the survey is framed according to the different stages of a project cycle. Consequently, the next section dealt with preparatory analysis, testing both the need for and methods used for this analysis. It then proceeded to baseline analysis, analysis and decision-support, implementation strategy and monitoring and evaluation, testing each section in more or less the same overall manner.

3. PREPARATORY ANALYSIS

The questions on this page relate to the preparatory analyses, i.e. the analysis that needs to be done before starting the project at the community level. The steps/questions are not necessarily in chronological order.

Experience has shown that benefits are only sustained when hardware installation is fully integrated with properly planned and implemented operation, maintenance and financing instruments.

As a result, the authors of the ITDG manual propose a Policy Environment Appraisal as well as a Community Stakeholder Analysis.

(Mulugetta et al., 2005: 101 - 110)

1. POLICY ENVIRONMENT ANALYSIS

The Policy Environment represents the broad context within which development takes place, and can be either an enabling or constraining factor. An understanding of the policy environment would yield information on the impact of policies on livelihoods and help in defining appropriate policy options. A **POLICY ENVIRONMENT ANALYSIS** allows one to gather and critically analyze information on the policies relevant to your work.

Do you think that this is a necessary step? Please justify your answer.

- 1. Definitely Yes
- 2. Possibly Yes
- 3. Possibly No
- 4. Definitely No
- I don't know

Why?

Figure 4.3: Screenshot 2 of Survey

4.6.3. Second questionnaire

The results of the first round of testing were assimilated from the different respondents and reworked into a feedback document that was sent out to respondents along with the second round questionnaire. This particular questionnaire strove to test the stability of responses, especially in areas where there seemed to be radically divergent views or a lack of clarity. Additional ideas, methods, definitions and indicators that arose as a product of the first round were also be tested with the rest of the group. The second round

questionnaire was again pilot-tested before being sent out, using the same pilot-respondents as in the first round.

The main aim of the questionnaire was not consensus, but rather gathering relatively stable input that may provide answers that expose the underlying inconsistencies and assumptions that make up the frameworks. In this sense, this particular Delphi is very similar to the policy Delphi.

4.7. Sample Profile

The participant profile is homogenous in the sense that all of the respondents are engaged in renewable energy in one way or another, whether this is through design, technology dissemination, rural implementation or research. However, further than that there does not seem to be much corresponding features between participants. They are from all over South Africa, involved in a number of different renewable energy technologies and/or activities, with very different levels of experience and educational backgrounds.

However, there seems to be two general “trends” in the respondent’s profiles: the one is that most of them, except for one, have been involved in renewable energy for less than ten years. The exceptional participant has been involved for more than double that amount of time, even though he has the lowest level of education in the group. The other “trend” is that five of the seven respondents were either educated in engineering or seem to have received relevant vocational training. The remaining two participants are from the social sciences, an area greatly removed from the world of engineering. This interaction of the different knowledge fields within the realm of renewable energy possibly again brings up the matter of trans-disciplinarity and its necessity in such a field.

The only other point of similarity is the fact that most of them, except one, is working in the private sector. Some of these companies directly interact with the public sector due to the fact that they are operating as concessionaires, while others do not seem to interact with government on such a direct level at all. The only participant not directly working

for the private sector seems to be caught somewhere in between since he is employed by a para-statal organisation that aims to benefit both the public and private sectors. Unfortunately, there are no respondents directly employed by the public sector, which may prove to be one of the major shortcomings of the study, especially when it comes to the generalisability of the results.

Another decisive factor in the selection of participants had also been internet access; since an online survey is being used, it is essential that participants are able to access it. Although it was possible to send a paper copy of the questionnaire to those participants that did not have access to the internet, it was not necessary, since all of the participants who agreed to participate in the study had access to the internet. The reasons given for non-participation did not include the problem of internet access, but rather had to do with enormous work-loads that did not afford them time to complete the questionnaire.

Table 4.1: Sample Profile

Respondent	State/ Province	Highest Qualification	Organization Type	Time involved in rural RE	Previous field	Aspects of RE involved in	Where in SA do you implement RE
1	Western Cape	MSc Engineering	Private Sector	8 years	N/A	Technology implementation with an emphasis on biogas digesters	Eastern half of the country, mainly EC, KZN, Limpopo,
2	Limpopo	Hon in Education	Private Sector	5 years	Rural Electrification in Namibia	PV	Limpopo Province
3	Gauteng	T3 Electrical Engineering Heavy Current	Private Sector	6 years	Heavy current electrical engineering - high voltage substations	Product wholesaler, systems design and integration	Telecommunications sector
4	Kwazulu Natal	BSc Eng in Electronic Engineering	Private Sector	3 years	Communications	Concessionaire process	Northern Kwazulu Natal
5	Western Cape	Matric	Private Sector	21 years	Civil Engineering	Water heating and PV	Western Cape
6	Gauteng/KZN	BA Hons	Private Sector	3 years (Not rural)	Education	Solar heating/Solar Electric	Not rural focused
7	Gauteng	MSc Engineering	Para-statal	5 years	Energy technology in general	Policy and Implementation issues	No specific area

Chapter 5: Research Findings

This chapter analyses the results obtained from the online Delphi study. Tables and graphs summarise the results, while the most significant results in every section is lifted out in the textual discussion. After the results of both rounds have been individually discussed, they are compared and noteworthy results and trends examined. These are then related to the research question and objectives, after which the chapter concludes with a section dedicated to the interpretation of the main results.

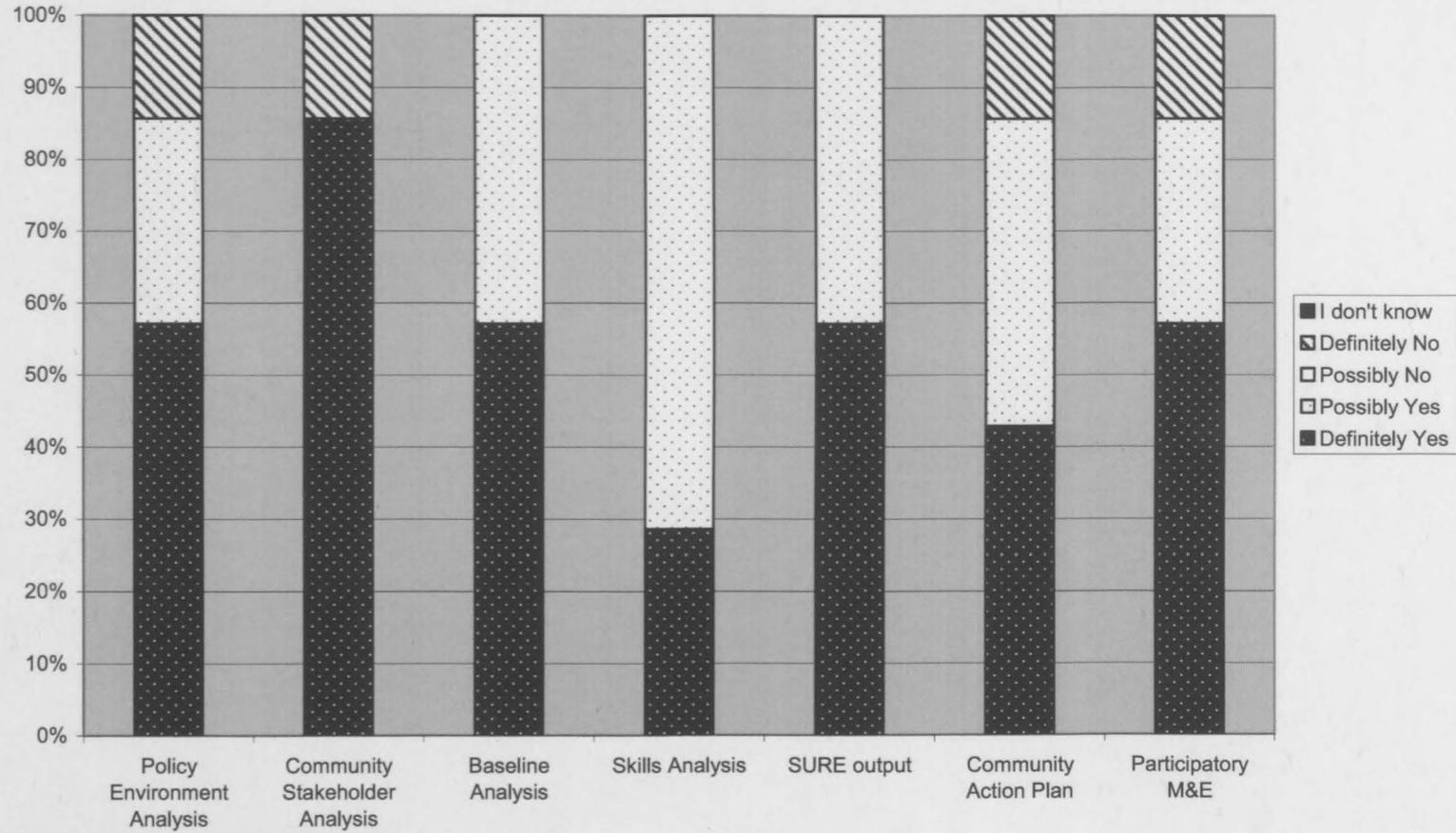
5.1. Round 1

The first round of the Delphi study delivered quite a few strongly opposing views, principally distinguished by a single market fundamentalist position that seeks to undermine the assumptions foundational to the implementation frameworks, and a majority that are generally supportive of the proposed framework.

As mentioned in the previous chapters, sections 1 and 2 of the survey dealt with the background to the study, as well as the demographic information of the respondents. These results have been discussed in the preceding section. Relevant research findings are therefore only found from section 3 of the Delphi study. This is the section that deals with preparatory analysis, looking specifically at the policy environment and community stakeholders.

Figure 5.1 lists the voting results associated with the different analyses and implementation methods proposed by the ITDG and RESURL. The chart clearly illustrates that all of these analyses and methods are rather strongly supported by the respondents, with only 2 of the 7 methods (*Skills Analysis and Community Action Plan*) receiving a *Definitely Yes* vote that is below the 50% mark. However, when one adds the *Possibly Yes* vote to the equation, it is clear that there is enormous support for all of the methods, notwithstanding some of the reservations of the voters.

Figure 5.1: Analyses Desirability - Round 1



Skills Analysis, the *SURE output* and *Baseline Analysis* are the only three proposed methods that did not receive direct opposition in the form of a *Possibly No* or *Definitely No* vote. When one investigates the reasons behind the *Definitely No* votes (see Appendix C), there emerges a clear picture of the aforementioned market fundamentalist opposition. Although the *Community Stakeholder Analysis* received a minority *Definitely No* vote, it is also the only proposed method that received unreserved majority support in the form of 85,7% *Definitely Yes* votes.

The ITDG manual has several methods that it proposes for both the Policy Environment Analysis as well as the Community Stakeholder Analysis. These methods were also tested in the questionnaire and are ranked accordingly (Figure 5.2). The most popular method for carrying out a Policy Environment Analysis was *Interviews and Workshops*, while the second place belonged to *Document Analysis, Questionnaires, SWOT* and *STEEP* analysis collectively. Third was *Stakeholder- and Problem-tree analysis*, with the *7-S model* occupying the fourth place. The *Activity/Responsibility Matrix* and *Micro-mapping methods* received no votes (Figure 6).

For Community Stakeholder Analysis, *Observation* and *Venn Diagrams* emerged as the most popular methods to carry out such an analysis, with *Questionnaires and Surveys, Secondary Data Analysis* and *In-depth Interviews* being second. *Wealth ranking* and *Focus Groups* received the least votes. For the Energy and Technology analysis of SURE's output, *Demand Patterns* and *Quantity of Energy Available* emerged as the most popular methods, with *End-use Analysis, Storage Capacity for Energy* and *Hours per day and Days per year of operation* being second. Although in the minority, the *None of the above* vote is significant as it signals a strong departure from the rest of the voting population. This vote was substantiated again through the use of market-based reasoning, appealing to the logic of one-on-one customer based renewable energy provision (Table 5.1).

The *Household Survey* emerged as by far the most popular method of information gathering for baseline analysis, while the area of Financial Analysis saw a much more

even vote distribution in the mid-percentages, with *Simple Payback* being only slightly more favoured than the other two methods, *Discounted Cash Flow* and *Internal Rate of Return*. Also, an *I do not know* vote was cast which, together with the relatively low voting scores for the section may indicate a lack of relevant knowledge on the area.

Environmental Analysis scores were again much higher, with all three suggested methods gaining scores of 70% or higher, all within a relatively close range of each other. The *None of the above* vote is again present, justified by referring to the significant differences between the Rich and Poor (which includes most of the rural population) in terms of their environmental impacts. The respondent therefore felt that it is unfair and unjustifiable to do an environmental assessment of the poor's energy sources and lifestyles while the rich are not handled accordingly.

Figure 5.3 provides a visual representation of the votes associated with the indicators proposed by RESURL for use in the SURE decision support system. It is noteworthy that no indicators received anything below 40% of the votes, with only three indicators receiving less than 50%. Interestingly enough, all three of these indicators come from two categories that, according to Figure 5.3, also display the largest amount of uncertainty if one looks at the fact that their indicators were overall the lowest scoring and both categories received an *I do not know* vote. They also both received a *None of the above* vote, again supported by market fundamentalist reasoning.

This state of affairs may very well be the result of a lack of knowledge on the part of the respondents regarding *Natural* and *Social Resources*, which is not such a far-fetched idea when one looks at the participant profile. However, at this point of the analysis it is too early to move beyond speculation. If this result remains, though, it may open up a number of very interesting questions regarding the South African renewable energy industry.

Figure 5.2: Analysis methods - Round 1

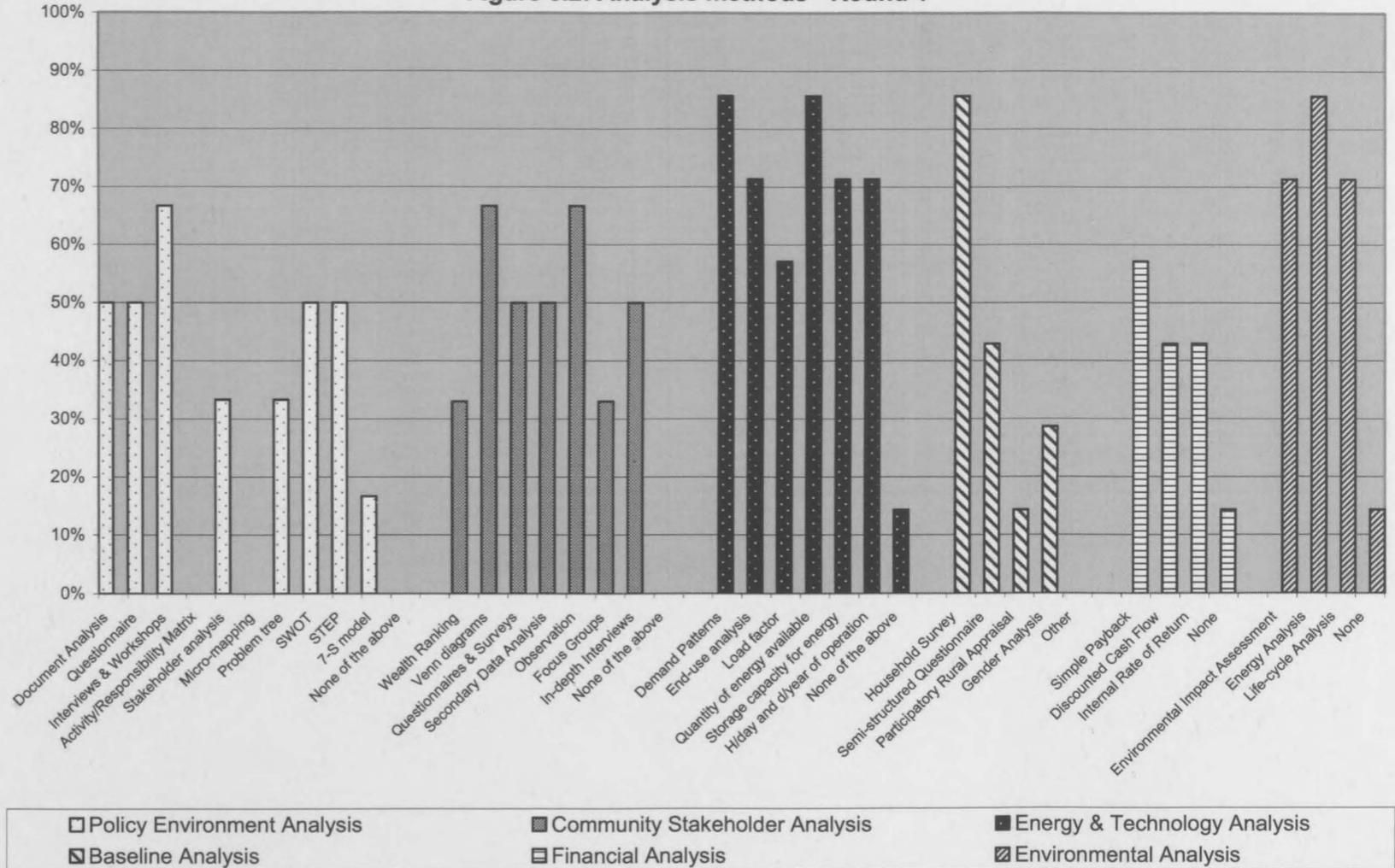
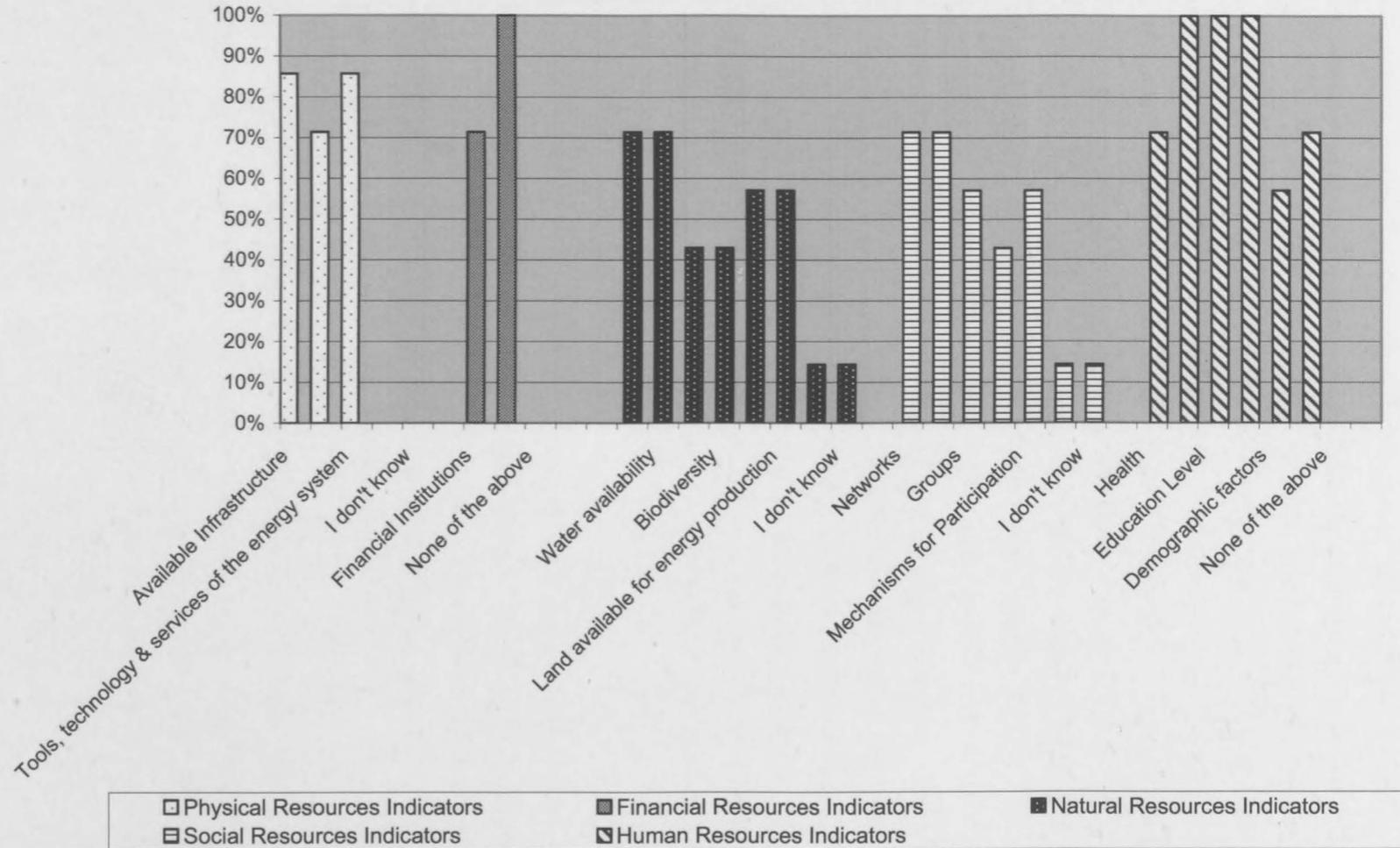


Figure 5.3: SURE Indicators - Round 1



Although much can be learnt from the first round through the analysis of the above charts, the possibility exists that these results can provide a false picture of the true responses of the respondents. The potential of eliminating the response anomalies is investigated in the analysis of the second round. However, it is important to explore some of the most important comments and feedback answers given by the respondents in the first round if one is to properly understand the study in its entirety.

One of the most significant results to emerge from the survey comments is that of a certain participant that responded quite aggressively against the proposed frameworks in a number of questions, which is interpreted as a market fundamentalist position. This has been briefly mentioned in the discussion of the results, yet the most important “comment” that the participant made is that he believes that renewable energy is supposed to be a transaction between a service provider and an individual client. The role of the public sector or any other associated utility company for that matter is explicitly attacked. This reasoning emerges time and again in his answers and opens up quite an important discussion around the perceptions surrounding renewable energy, even in the industry, as well as the different roles of the market and the public sector in the renewable energy industry.

Feeding into this, there is an important comment regarding the South African policy arena, where it is mentioned that the country’s huge number of (developmental) policies may result in a paralysis on the part of those implementing rural RE. Apart from this particular comment, the first two (see appendix C) seem to indicate a general misconception of the role of policy with regards to rural RE.

The question regarding *Community Stakeholder Analysis* seems to have generated the largest degree of consensus in terms of comments among the participants, indicating a strong agreement on the importance of involving all parties concerned and not just those providing the funding. As was mentioned before, this result is also evident in the voting distribution for the question.

For the second round, a few questions were added to the questionnaire. These questions are a result of the responses from the first round and were suggested by the participants themselves.

The first question that was added regards the need for per capita income analysis and forms part of the preparatory analysis section. Additionally, there were indicators added to the SURE capitals; *Access to Micro-finance* and *Knowledge of Co-operatives* were added as possible indicators in the Financial Resources section. Based on an argument proposed by a participant, *Population Density* was also added as a possible indicator of Natural Resources. So also *Access to Clean Water* was added as a possible indicator of Human Resources.

It seemed that there was quite an amount of confusion surrounding the purpose of a *Skills Analysis*, if one studies the comments. For this reason, a question was added that asks participants to select or add what the purpose(s) of a skills analysis should be. These purposes have been classified as indicators of *Maintenance Ability*, *Project Ignorance among the Community (Project Sustainability)* and/or *Income Level*.

Apart from these questions, there was not much difference between the questionnaires of the first and second rounds. As was mentioned in the previous chapter, the reason for this is related to the need to test the stability of responses after participants have been exposed to the responses of their fellow respondents.

5.2. Round 2

The participant profile changed slightly for the second round of the survey since one of the participants failed to respond. Although this obviously influenced the results of the second round in particular and the study in general, the results are presented, discussed and interpreted in much the same manner as the first round while leaving room for a greater degree of uncertainty in terms of significant results. As the second round of this

Delphi study served primarily as a test of the stability of responses in the first round, the actual results of the study are not expected to be affected significantly.

In terms of the Analyses Desirability results, the second round has two significant results that need to be mentioned. The first is the rather obvious additional analysis that has been tested: *Per Capita Income*. The results for this indicator show that there is a rather strong degree of consensus on its desirability, with slightly less than 70% of the respondents casting a *Definitely Yes* vote. This is further strengthened when one considers the *Possibly Yes* voting percentage, which, together with the *Definitely Yes* vote, pushes the overall *Yes* votes over the 80% mark. The remainder is made up by *Possibly No*, justified by the apparent difficulty involved with attaining the needed income information from rural communities.

The second significant result to emerge refers to a more general trend in the voting patterns, where one notices a rather significant stabilisation in terms of the desirability of the analyses. This stability is not only obvious with regards to the *Yes* votes, but is also noticeable with the *Definitely No* votes, where there does not seem to be any change in the distribution except for the Participatory Monitoring and Evaluation vote. Here, the *Definitely No* vote has disappeared and been replaced with a *Possibly Yes* vote, justified from a marketing perspective. The justification of the aforementioned *Definitely No* votes increased, however, in terms of determination and “aggressiveness” from the first round.

The proposed analysis methods for the policy environment also seem to display a more evenly distributed voting pattern, with *Document Analysis*, *SWOT* and *STEP* all experiencing quite a decrease in terms of popularity. *Questionnaires* and *Interviews and Workshops* seem to still be the overall favourites, while the *Problem tree-method* and *Activity/Responsibility Matrix* methods have also received votes where in the first round they did not receive any. Interestingly enough, there is a *None of the above* vote, which was not present in the first round. Also, *Focus Groups* has been included as a possible method after the suggestion was made in the first round; voting scores for the method

shows that, along with *Questionnaires* and *Interviews and Workshops*, it is one of the most popular methods for this type of analysis.

There are no real noteworthy differences in voting distribution for Stakeholder Analysis, except for a significant increase in favourability for *Questionnaires and Surveys*, which increased from 50% to more than 80%. The distribution for Energy and Technology Analysis also appears to be much the same as the first round. The Information gathering methods *Semi-structured Questionnaires* and *Participatory Rural Appraisal* display significant increases in the second round, while one participant has added *Product presentation and demonstration* as a possible extra method to be used for baseline analysis.

Although all three proposed Financial Appraisal methods slightly increased, there is again an *I do not know* vote that has been cast. The Environmental Analysis methods, which were quite high scorers in the first round, all three also increased in the second round, possibly alluding to an increase in certainty among voters. The *None of the above* vote also maintained its certainty, with the same reasons stated as was used in the first round.

There was a general increase in response percentages among the SURE indicators, with the exception of the Human Resources Category, where a slight decrease is apparent, and the Physical Resources category, where no real change seems to have taken place. However, an important difference for the Physical Resource category is the *None of the above* vote, which was again substantiated through the use of market-based rhetoric. The most important result in the area of the SURE indicators is the support given to the additional suggested indicators: *Access to Micro-finance* and *Knowledge of/Experience with Co-operatives* (Financial Resources Indicators), *Population Density* (Natural Resources Indicators) and *Access to Clean Water* (Human Resources Indicators). Additionally, *Access to Information/Energy* was suggested in the second round as a possible indicator for Human Resources.

Another addition to the results is concerned with the reasons behind the need for Skills Analysis. *Indicator of Income*, *Local Maintenance Ability* and *Measure of technological ignorance* were provided as possible reasons based on the suggestions from the first round, along with the options *Other* and *Not Applicable*. In step with the literature, *Local Maintenance Ability* emerged as the clear favourite, with *Measure of Technological Ignorance* receiving the second highest amount of votes. *Skill Enhancement* was also suggested as a possible reason behind the choice to do a Skills Analysis.

The apparent lack of knowledge regarding *Natural* and *Social Resources* that emerged from the first round of the Delphi study seems to have subsided in the second round: the *I don't know* votes that were present for both realms in the first round, are not present in the second round. The voting distribution for both of the rounds does not seem to show significant fluctuations, with percentage voting scores for indicators in both realms being mostly above 65%. This can in part be ascribed to the smaller number of respondents in the second round. The amount of comments associated with the indicators is also less than in the first round, which is not surprising since the indicators for both rounds are mostly the same, with only *Population Density* having been added to the *Natural Resources* indicators. The few comments in the second round seem to reflect more of a distinctive understanding and viewpoint of *Natural* and *Social Resources*, although the comments that were made in Round 2 are very much in line with the comments of the corresponding respondents in Round 1.

Those respondents that indicated some lack of understanding in Round 1 through their voting choice and/or comments did not respond in the same way in Round 2. Instead, the *I don't know* votes were changed to other indicators and no comments were left. This may be an indication of a learning curve between the two rounds with regards to the indicators. It may also, however, illustrate a change of mind not at all associated with a learning curve but indicative of impatience or frustration with the questions.

The point is that there is insufficient evidence from the two rounds to clearly indicate a lack of knowledge on the part of the respondents regarding *Natural* or *Social Resources*.

Although the first round responses seem to indicate this possibility, it will have to be investigated in greater detail before any such conclusions can be drawn.

In summary, the second round of the survey seems to display an overall trend of increased support for the frameworks and their methods. The additions suggested in the first round were also met with acceptance from the majority of the respondents. There are also no major fluctuations in terms of individual responses, with most respondents maintaining their original responses. The second round therefore serves as good confirmation of most of the results of the first round.

Figure 5.4: Analyses Desirability - Round 2

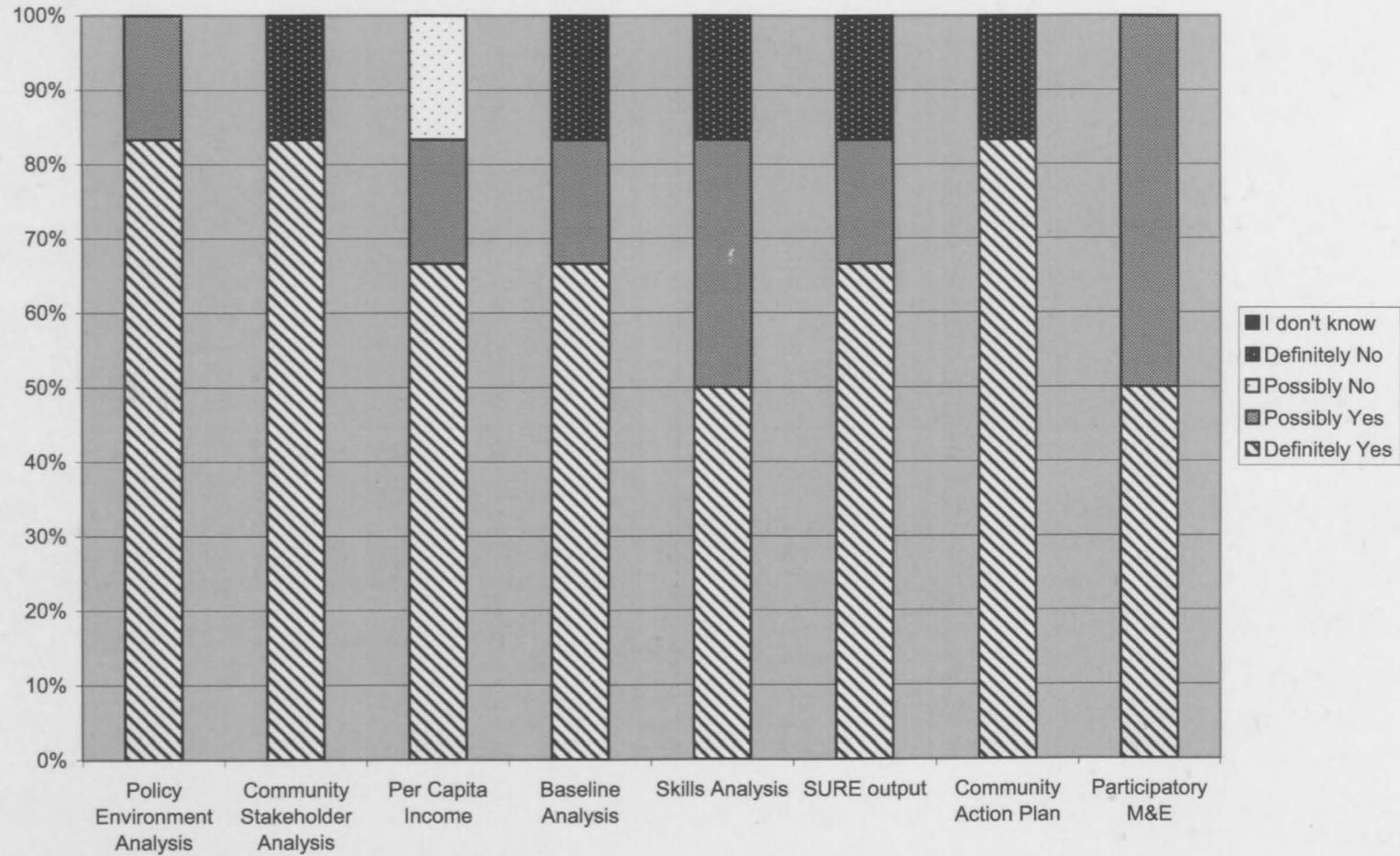


Figure 5.5: Analysis Methods Round 2

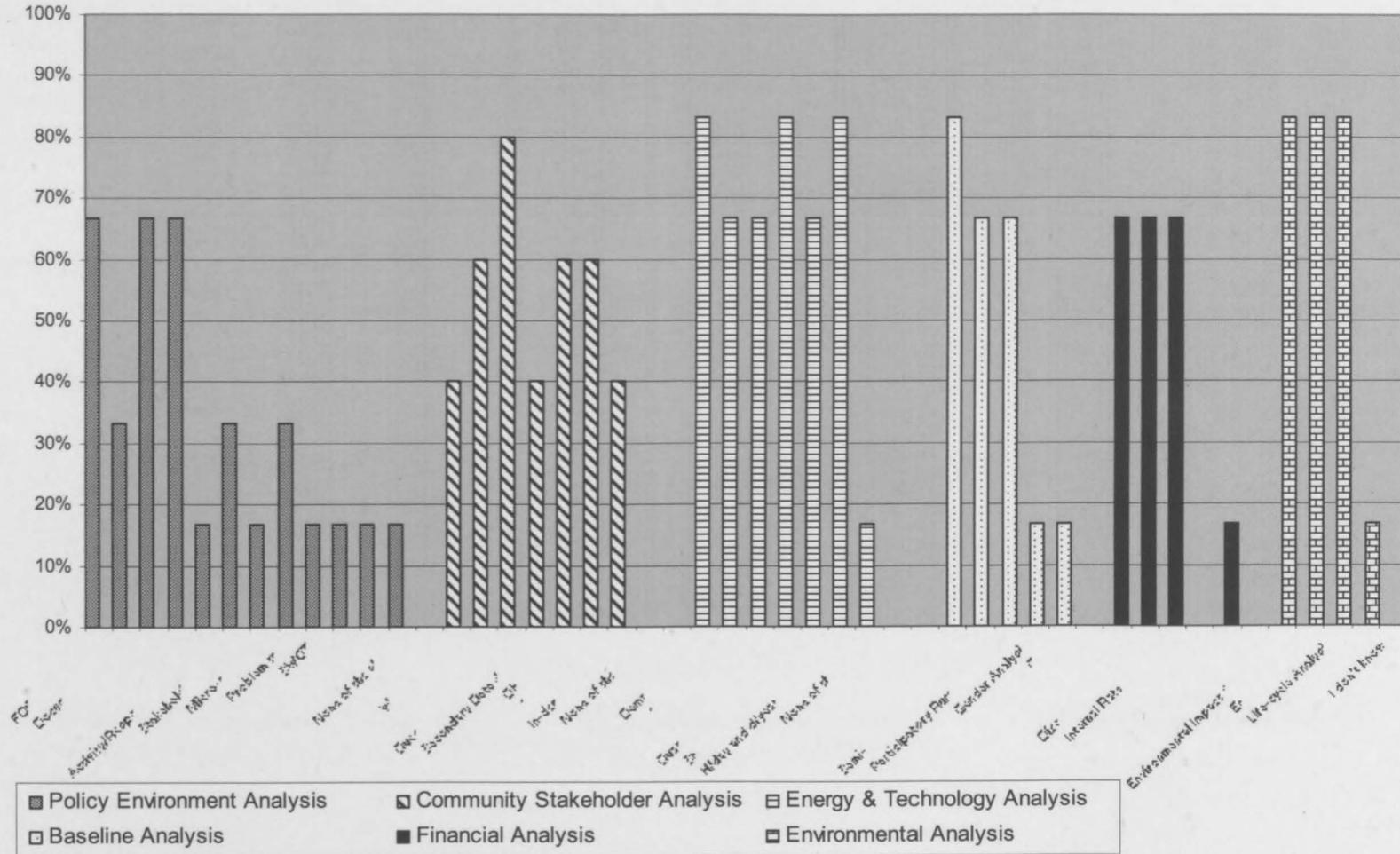


Figure 5.6: SURE Indicators - Round 2

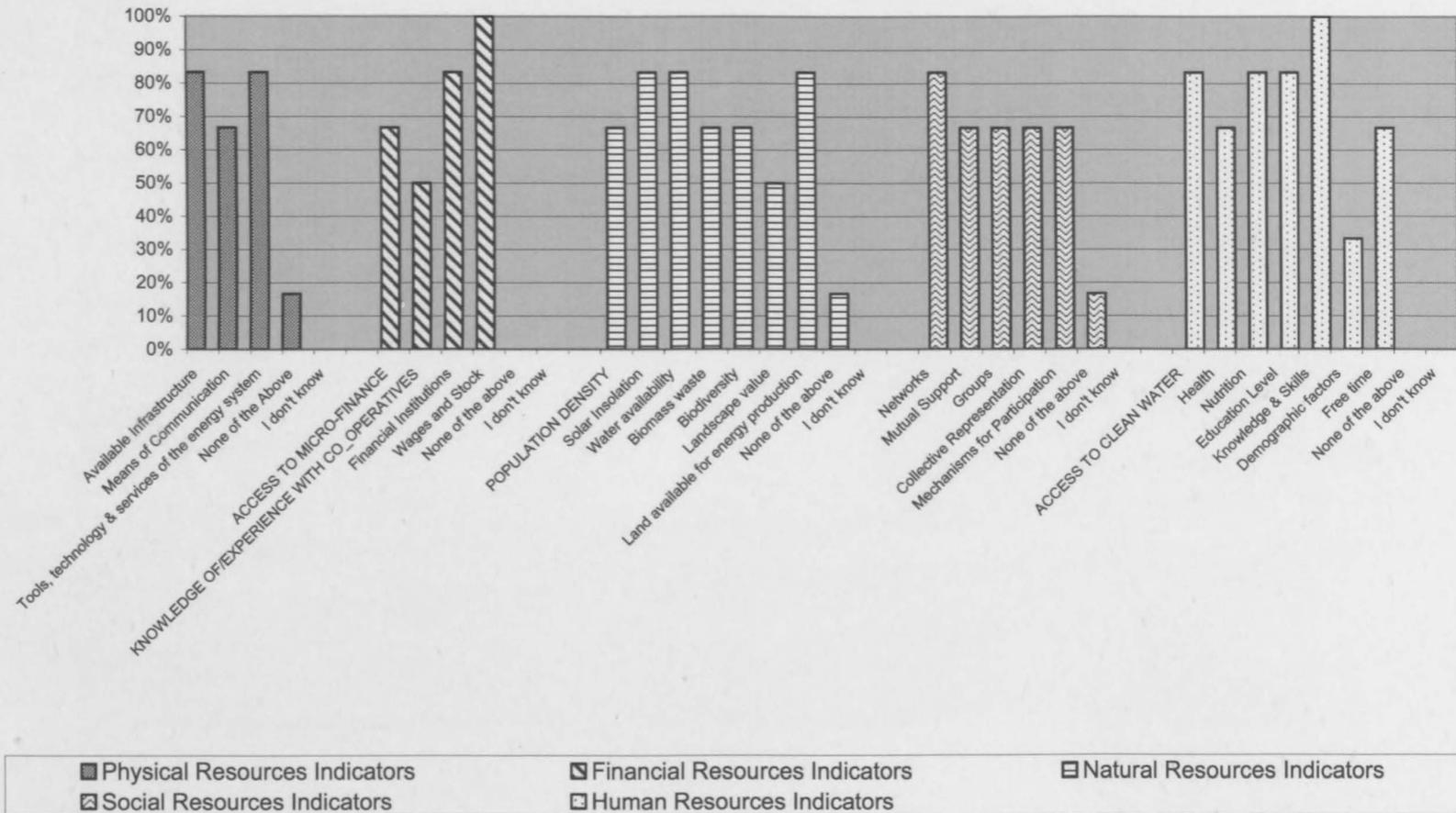


Figure 5.7: Reasons for Skills Analysis

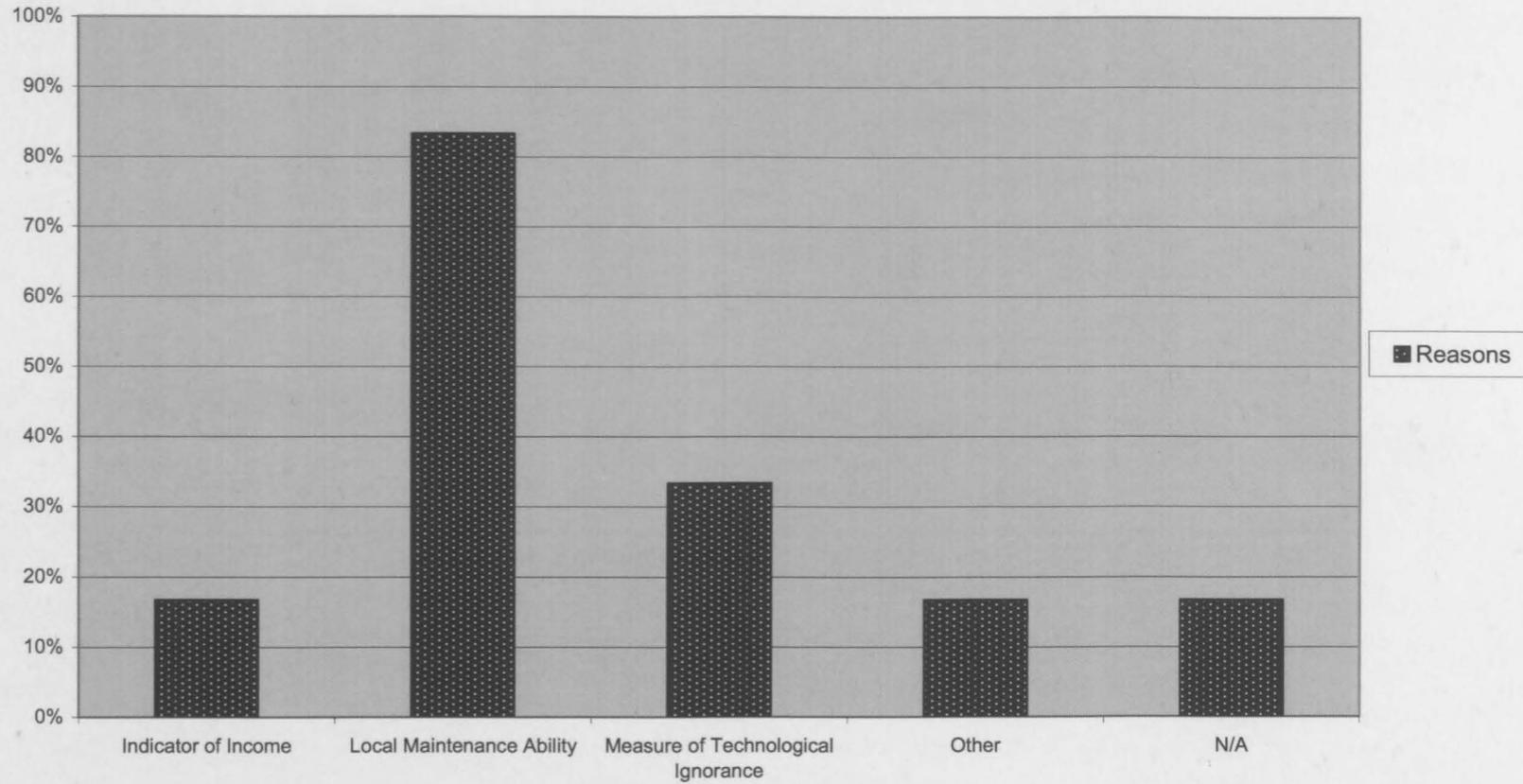


Figure 5.8: Comparison: Policy Environment Analysis - Rounds 1 & 2

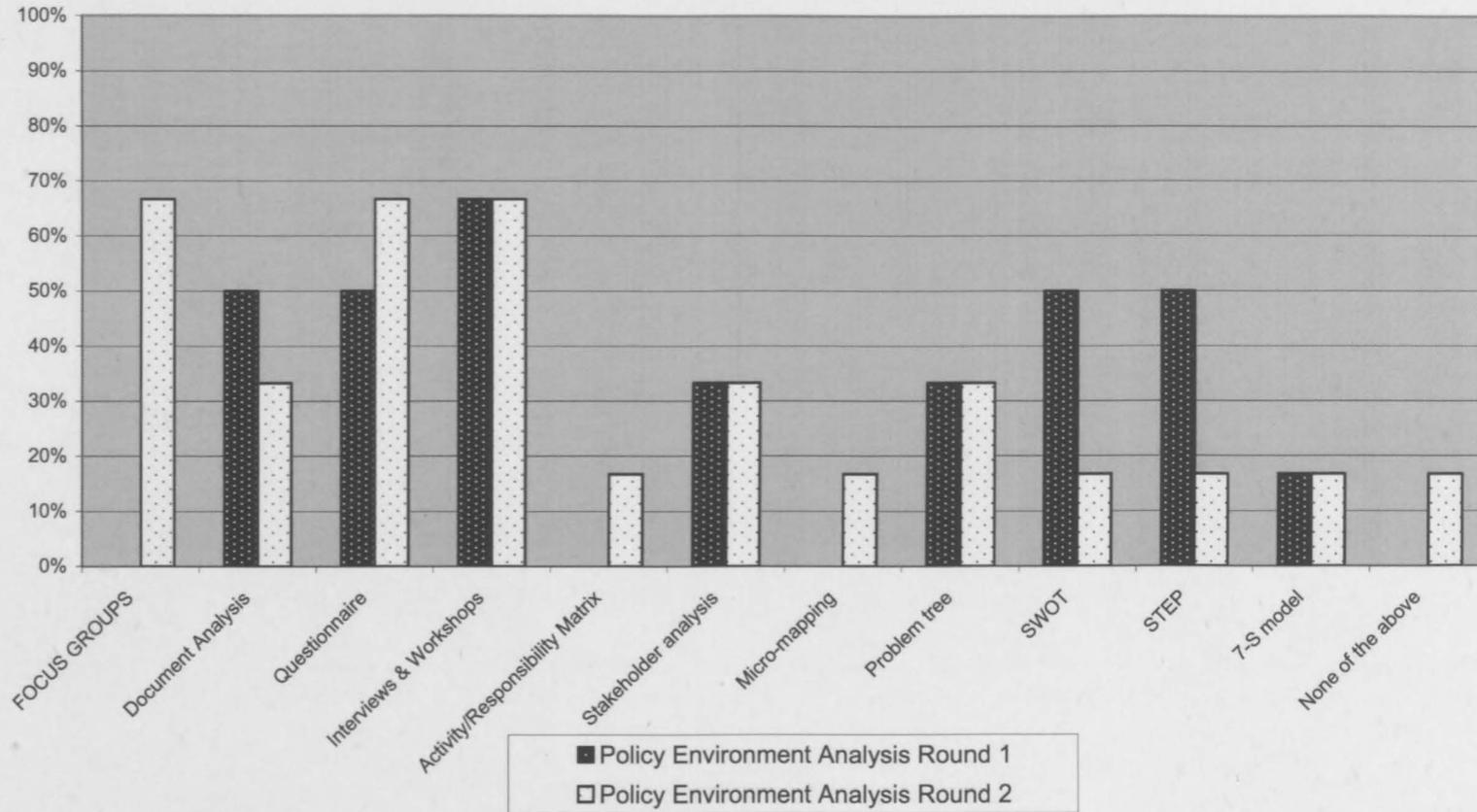


Figure 5.9: Comparison: Community Stakeholder Analysis - Rounds 1 & 2

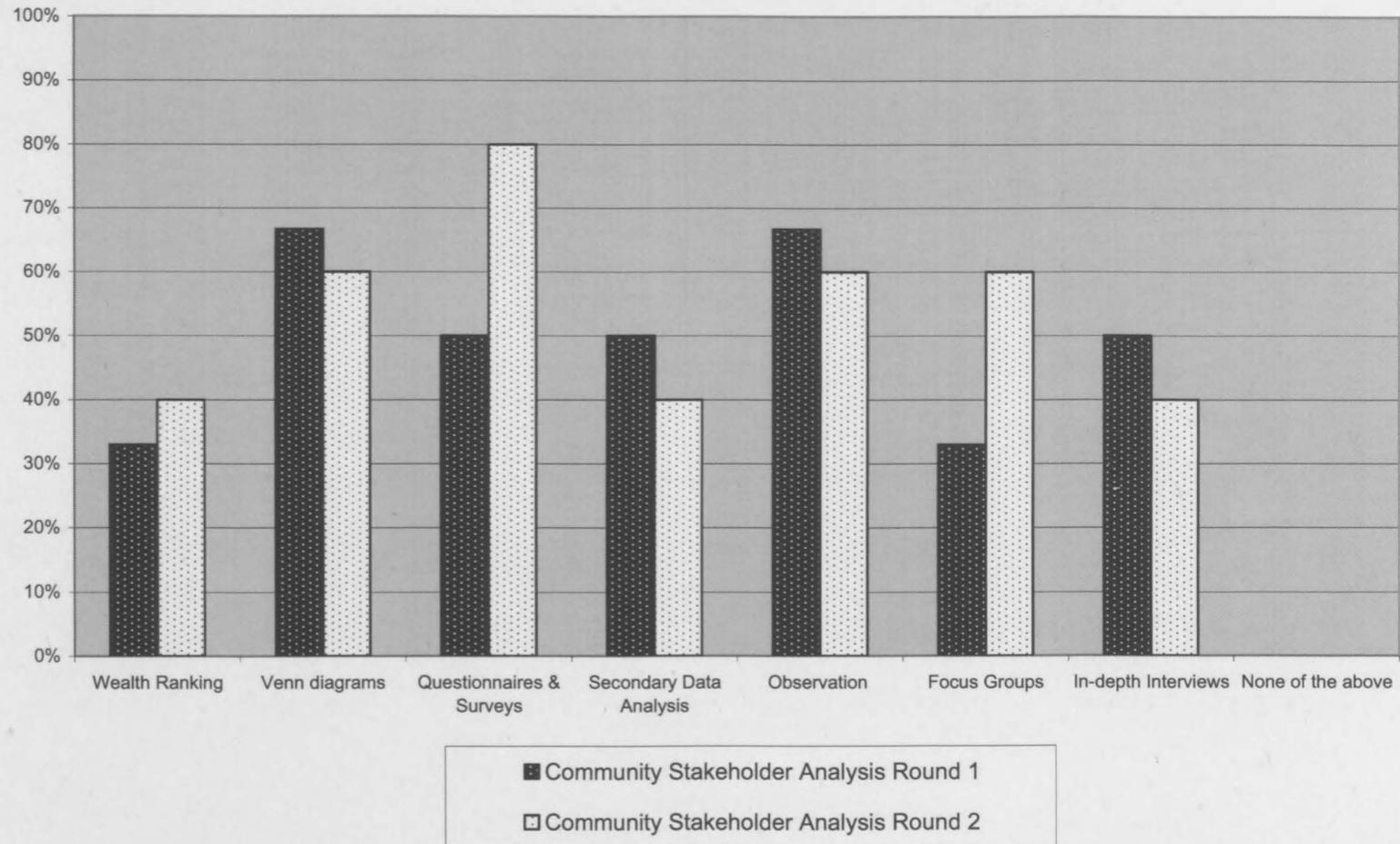


Figure 5.10: Comparison: Energy & Technology Analysis Rounds 1 & 2

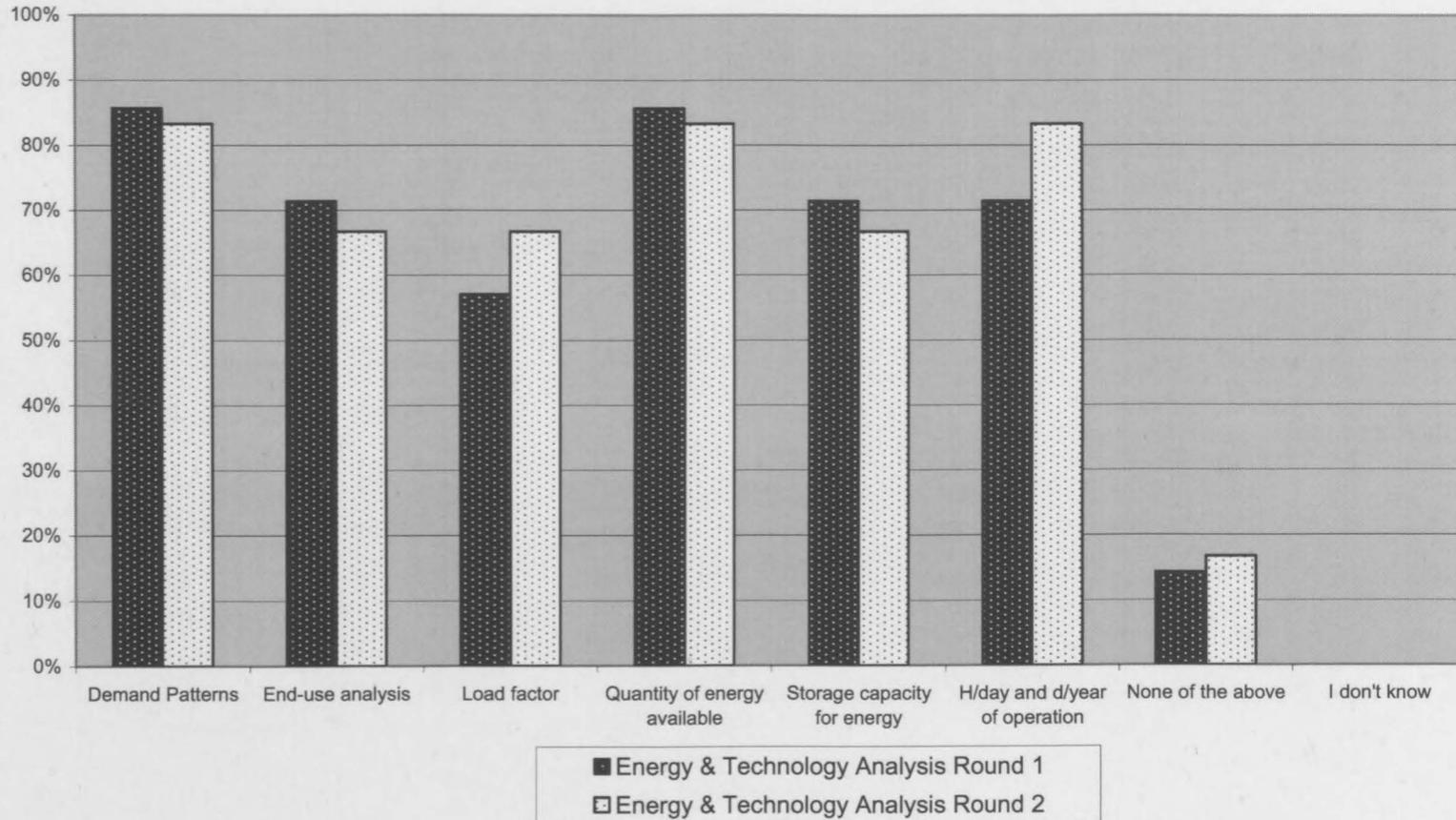


Figure 5.11: Comparison: Baseline Analysis - Rounds 1 & 2

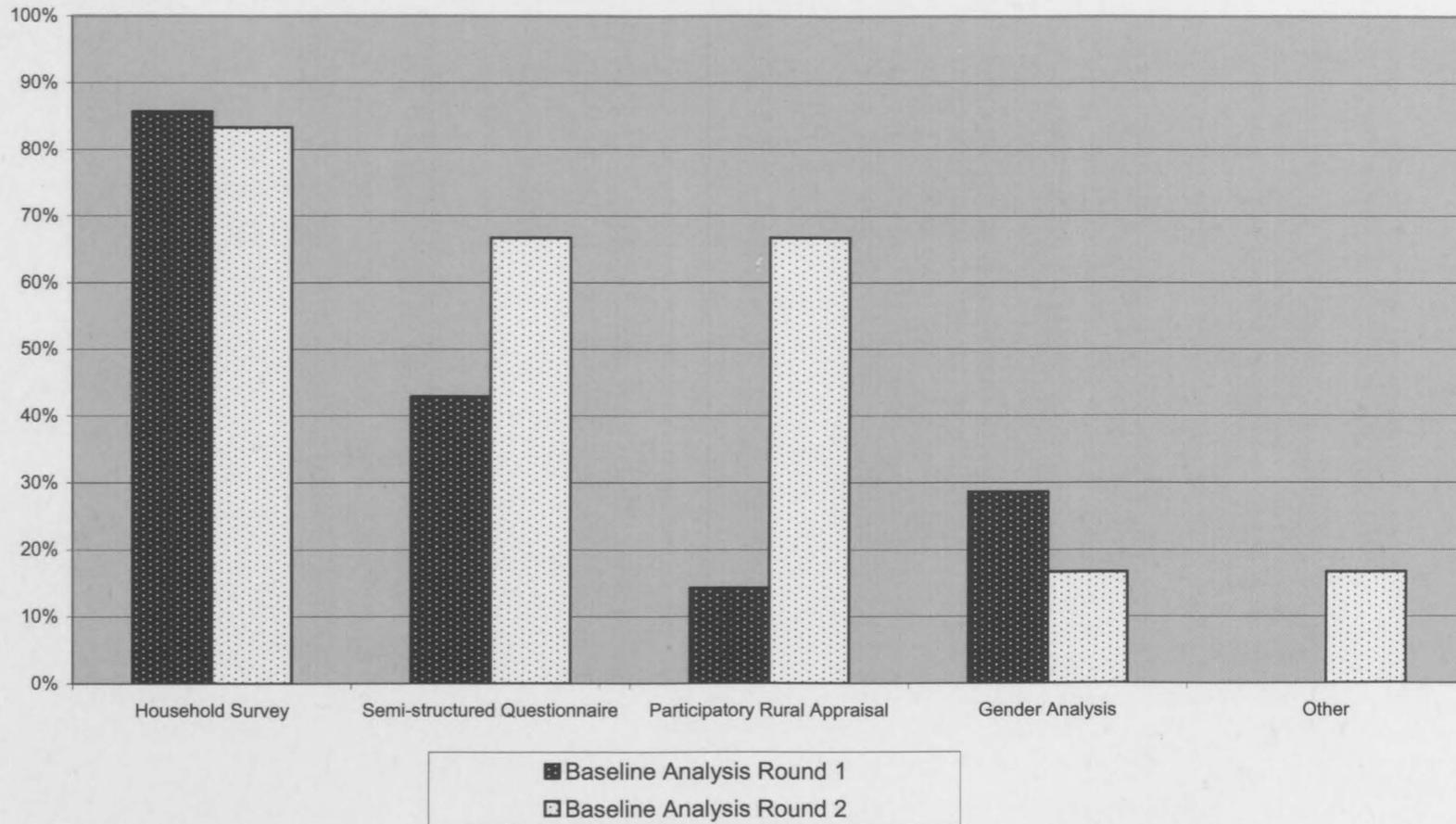


Figure 5.12: Comparison: Financial Analysis - Rounds 1 & 2

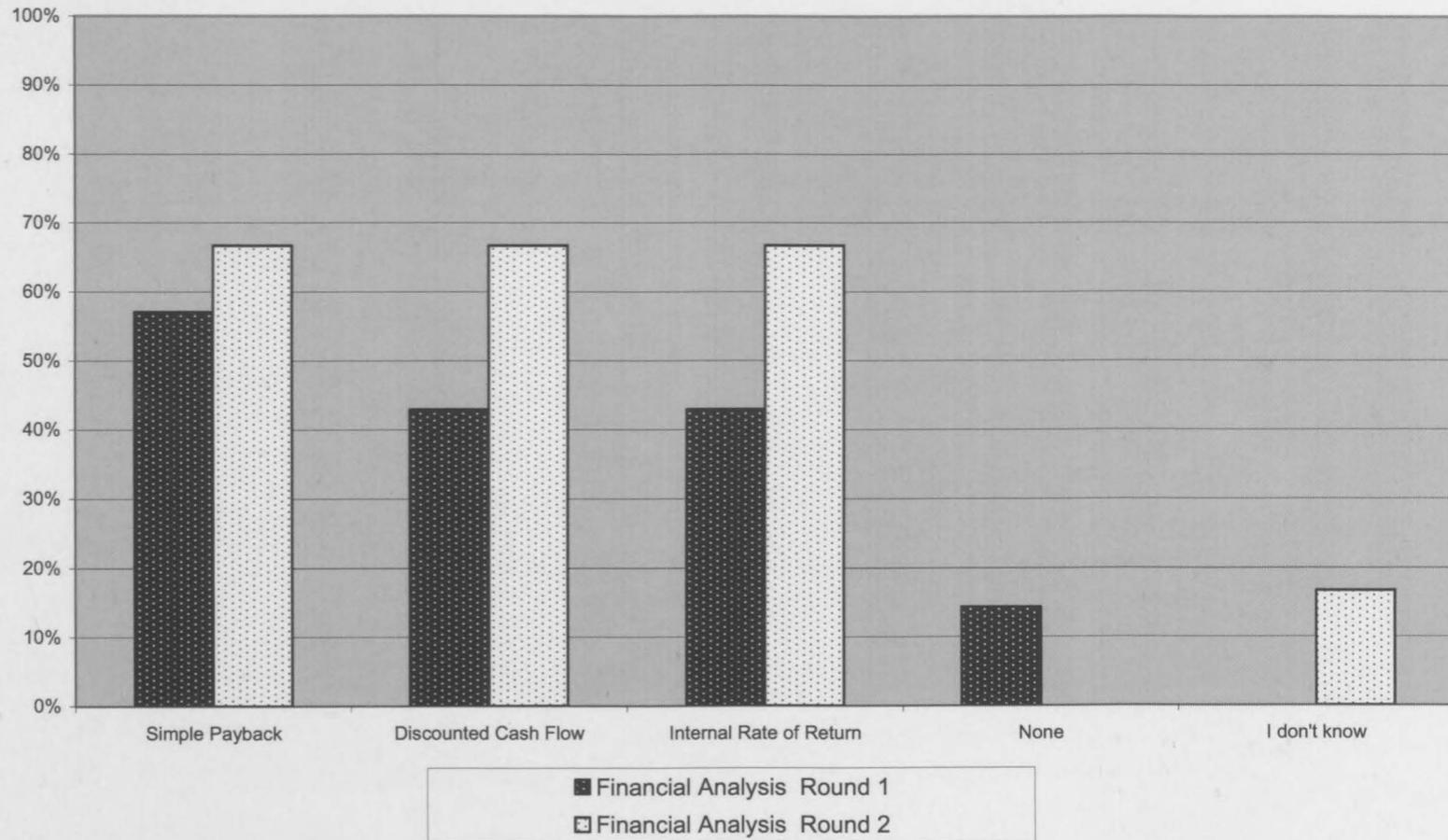


Figure 5.13: Comparison: Environmental Analysis - Rounds 1 & 2

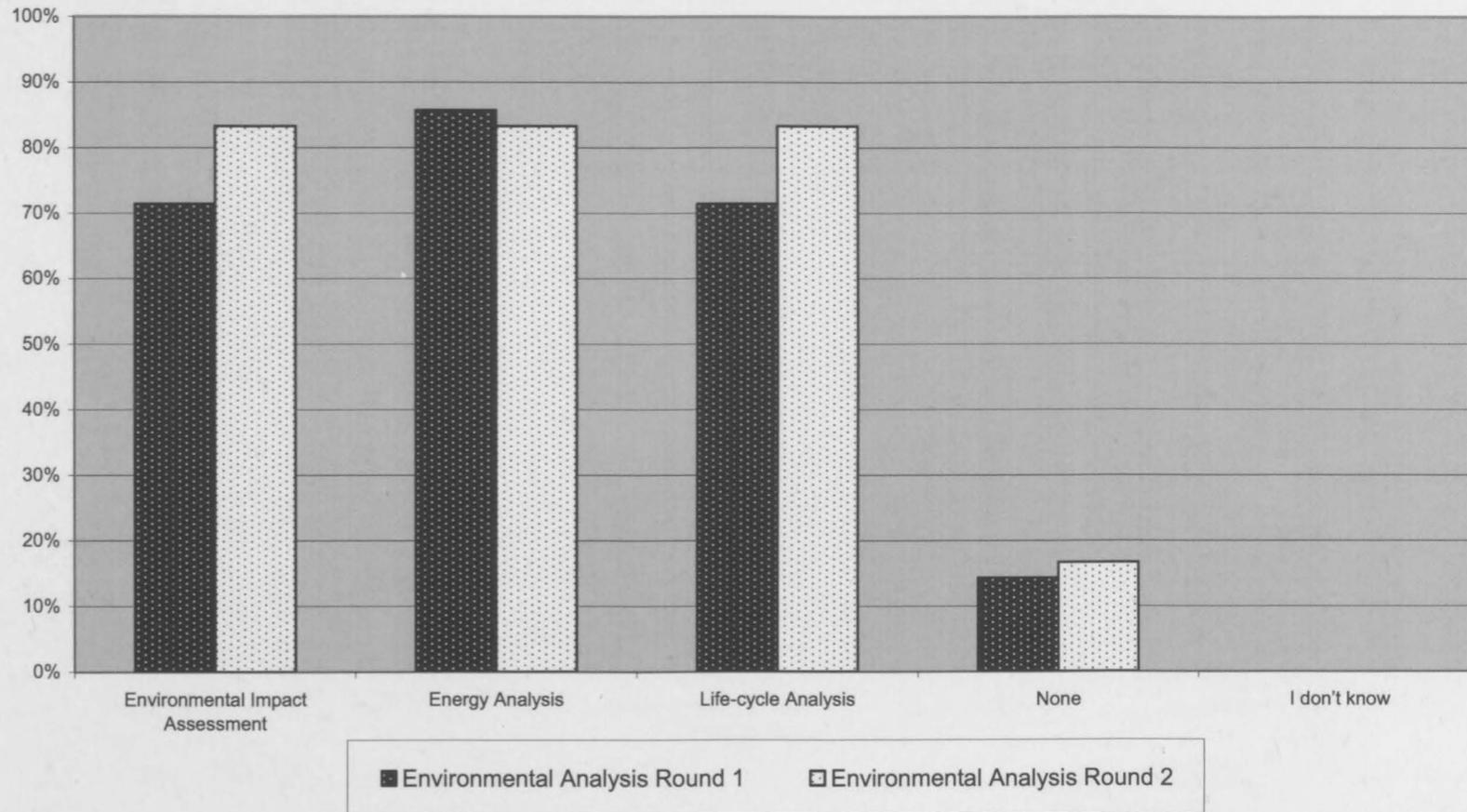


Figure 5.14: Comparison: Physical Resources Indicators - Rounds 1 & 2

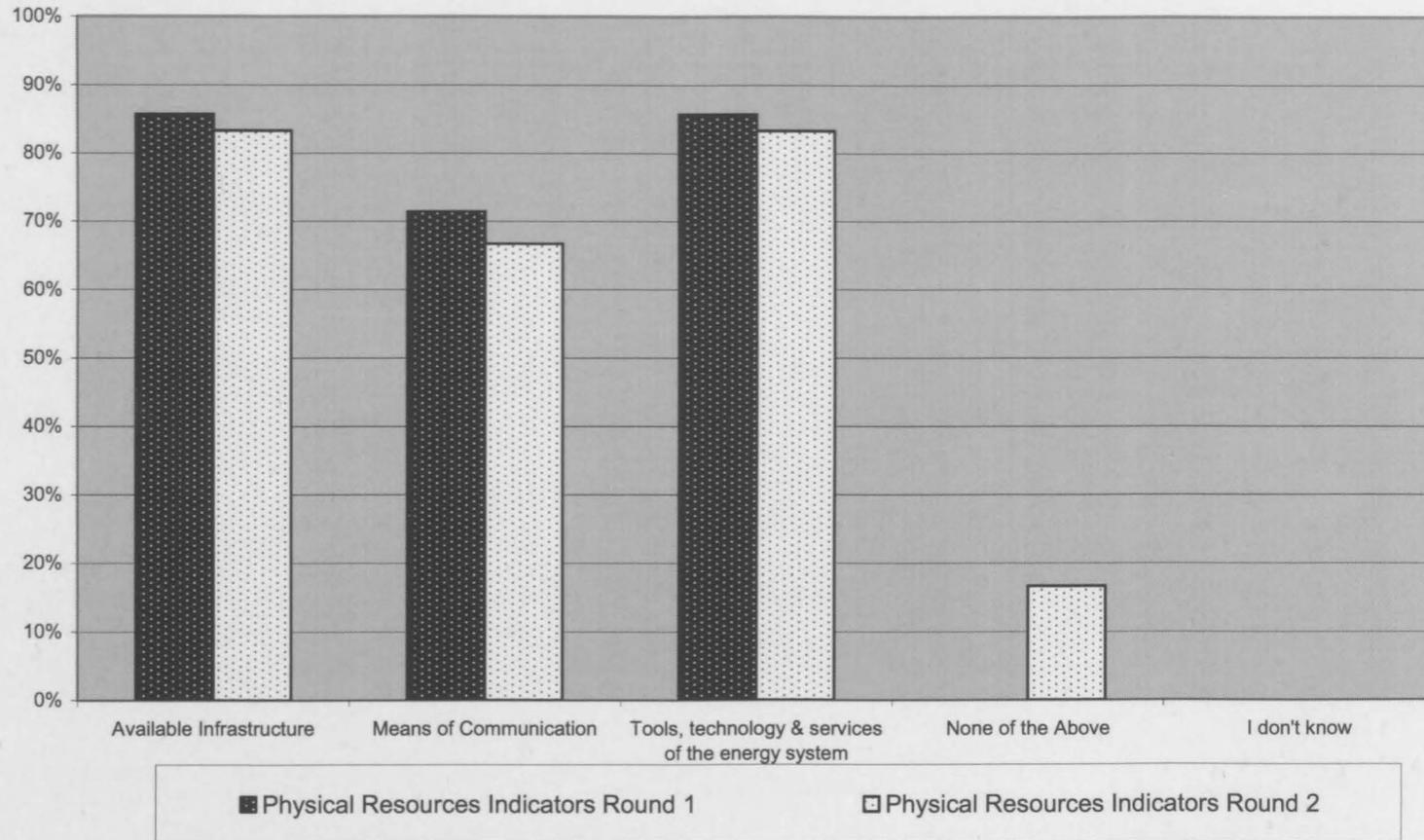


Figure 5.15: Financial Resources Indicators - Rounds 1 & 2

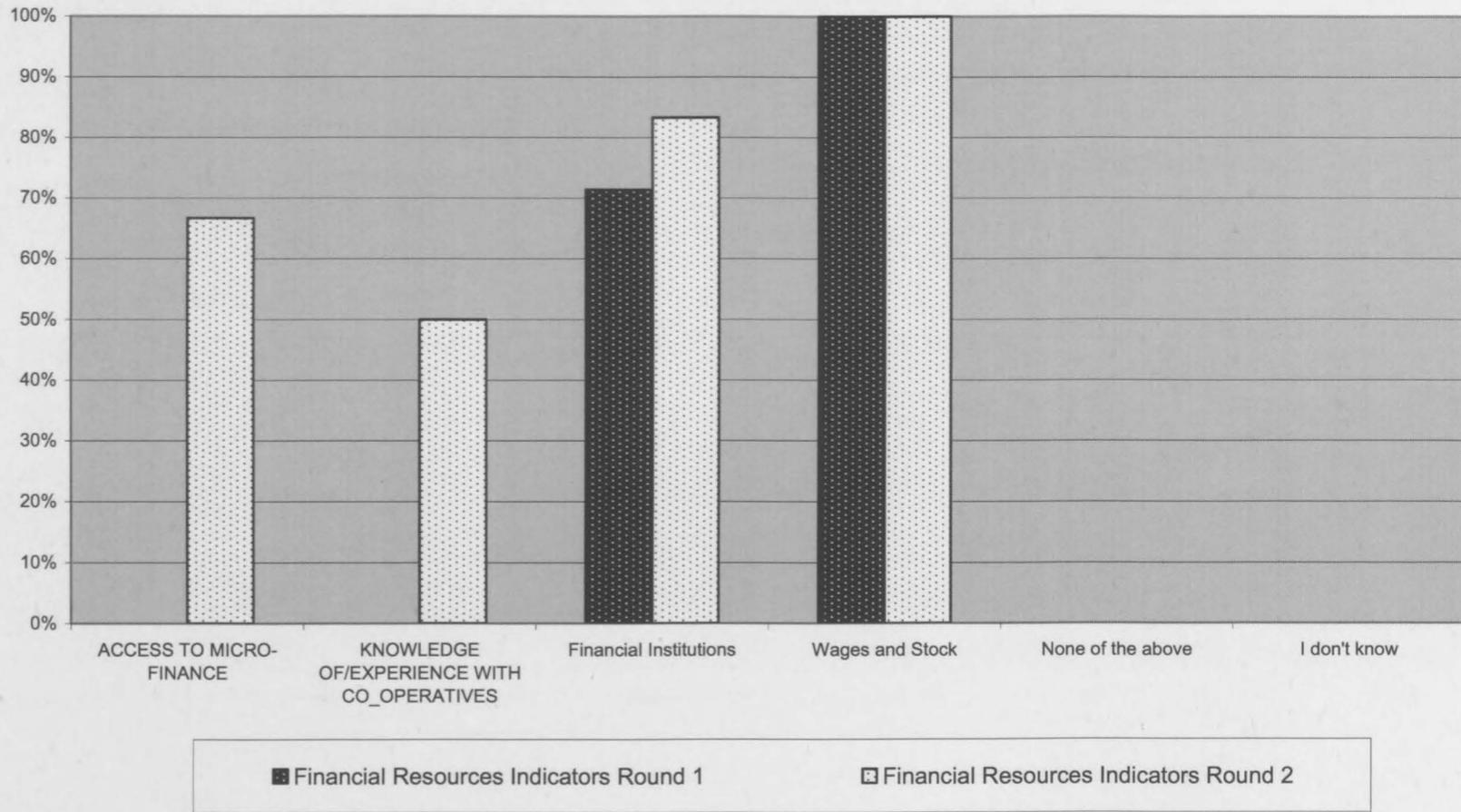


Figure 5.16: Comparison: Natural Resources Indicators - Round 1 & 2

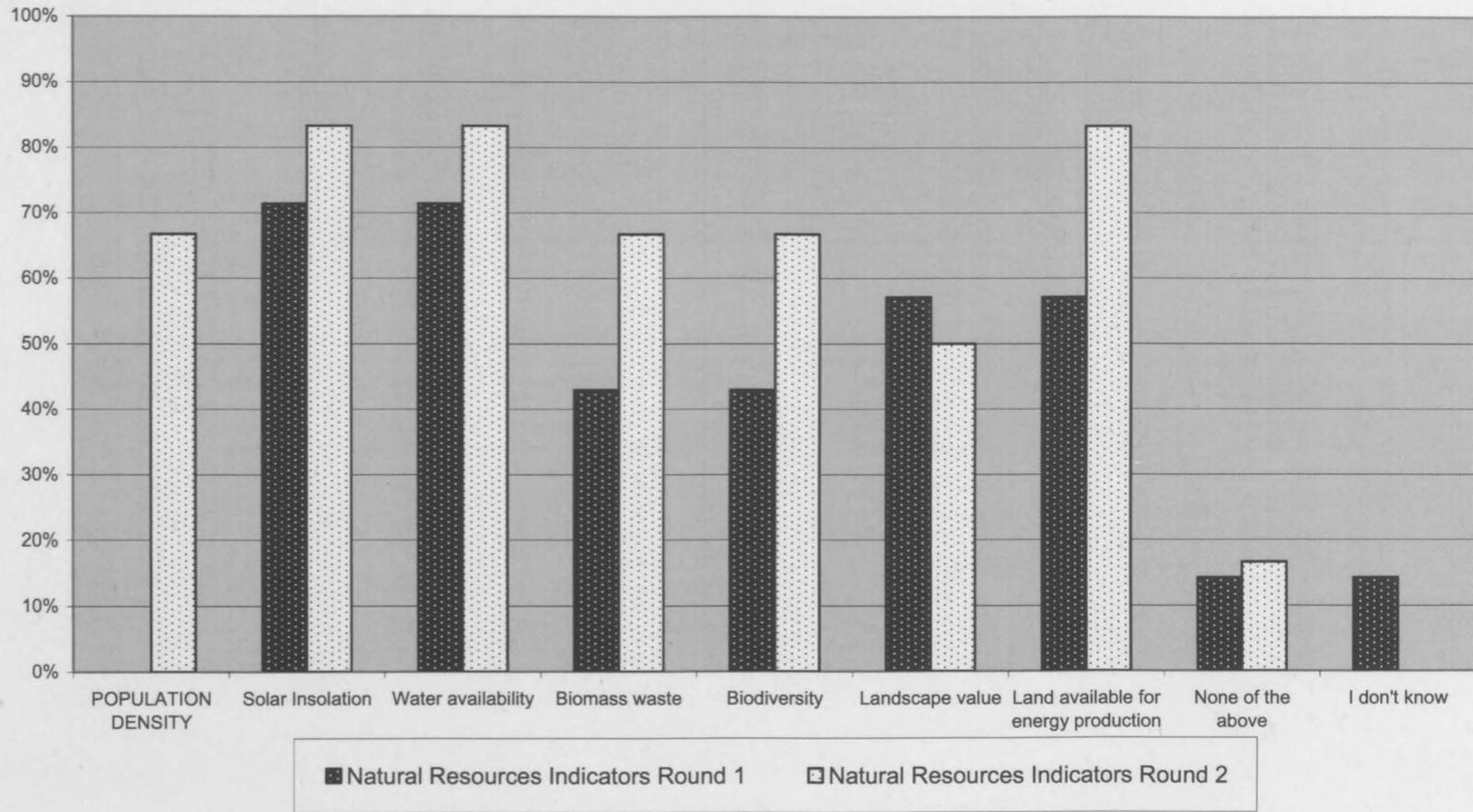


Figure 5.17: Comparison: Social Resources Indicators - Rounds 1 & 2

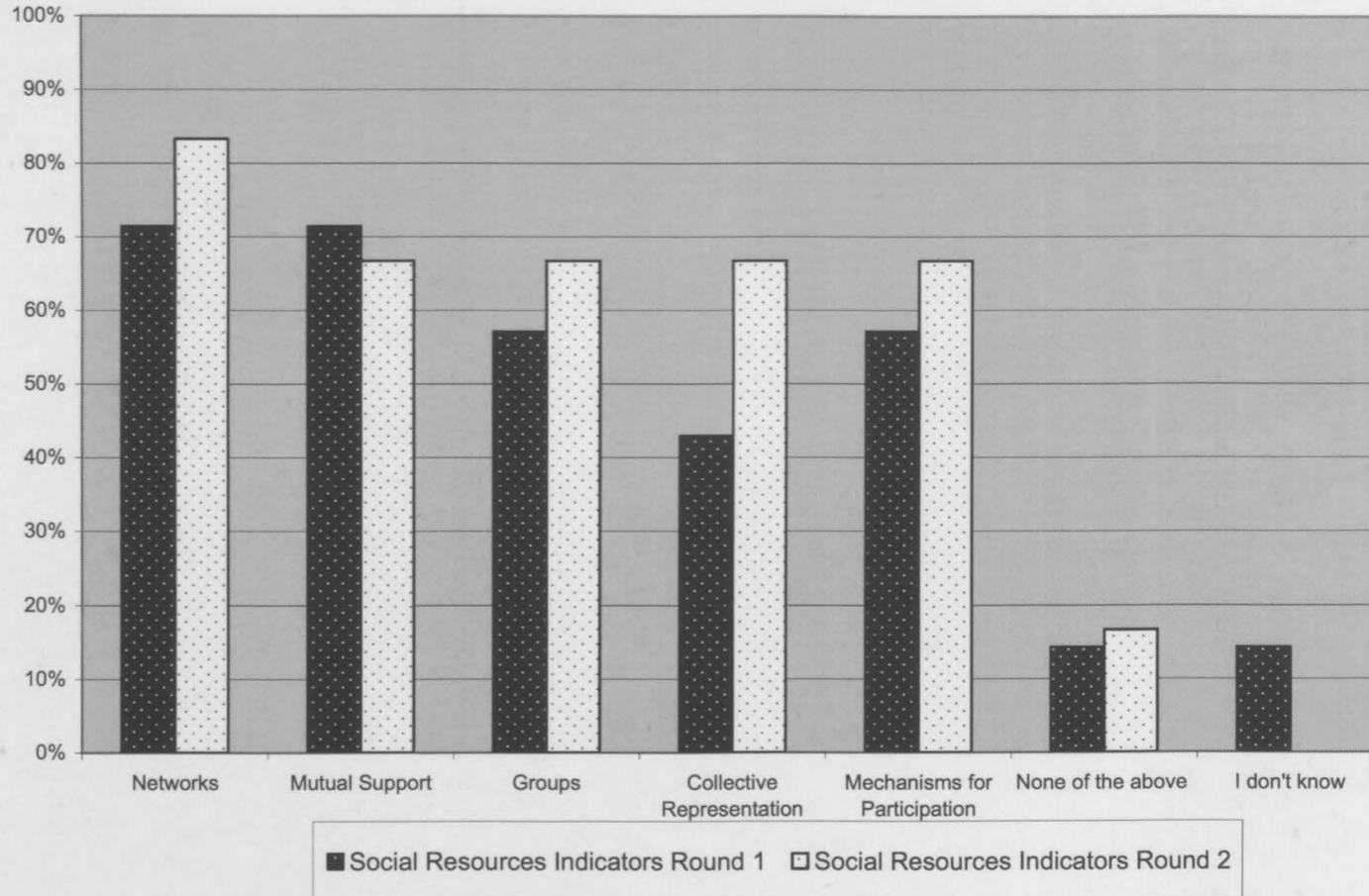
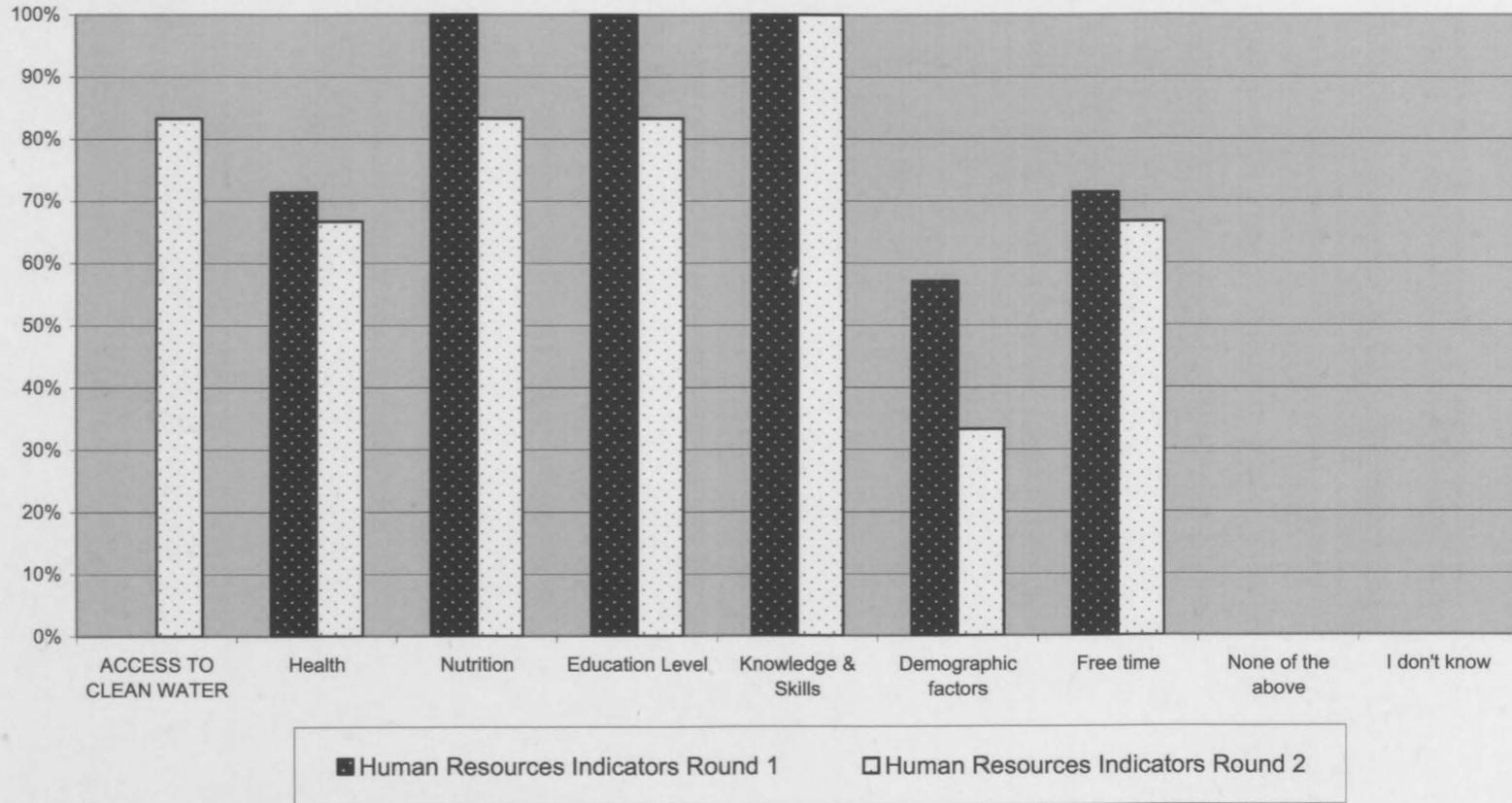


Figure 5.18: Comparison: Human Resources Indicators - Rounds 1 & 2



5.3. General Analysis

Table 5.1: Noteworthy Contributions

General area of contribution	Comments
Policy	<i>Can be both enabling and constraining.</i>
Community	<i>Involvement and Acceptance very important.</i>
Practicality of certain analyses/ Methods	<p>Baseline Analysis: <i>Only practical if need exists for later impact assessment. However, another point is that most energy projects have a big enough impact to warrant an impact assessment.</i></p> <p>Per Capita Income: <i>Difficult to gather information in rural areas.</i></p> <p>Policy Environment Analysis: <i>Large amount of policy may result in "paralysis".</i></p> <p>Community Action Plan: <i>may only serve as a method of ensuring community participation in something they don't need/want. Also, this kind of action usually requires large amounts of funding.</i></p>
Indicators	<i>There seems to be a need for/inclination towards meta-indicators.</i>
RE Reputation	<i>Poorly planned and executed RE projects seem to cause much harm to the industry.</i>
Ownership vs. project-based provision	<p><i>Project-based provision destroys the need, therefore also the industry.</i></p> <p><i>Temporary nature of projects automatically means that maintenance and assistance may disappear once project is finished.</i></p>
System Design	<i>All factors of the end-user community need to inform the design.</i>
Financial Resources	<i>In SA it is very difficult for the poor to access financial institutions. Micro-finance and co-operatives are therefore very important.</i>
Social Resources	<i>Seen as inherent yet very important part of (poor) rural communities.</i>
Technological Ignorance (from the community)	<i>Seen as a possible significant hindrance to sustainability of energy implementation.</i>
Product/Project vs. People orientation	<i>Most answers on this issue reflect the fact that project success is dependent on people; therefore you must get people to accept the project. "...get buy-in..." and "...if you want the project to work you must involve the people..." are two significant examples of comments that support this. Also see Practicality: Community Action Plan comments.</i>
SURE	<i>Format of output is very helpful, especially for product comparison.</i>
Financial Assessment tools	<i>No definite favourites, very context-dependent.</i>
PM&E	<i>Proponents feel quite strongly about the need for and importance of PM&E.</i>
Private vs. Public RE	<i>Strong minority antagonism towards any RE provision that isn't market-led.</i>

From the analysis of the aforementioned response documents of rounds one and two of the Delphi study, a few interesting and possibly important points were identified. These are summarised in Table 5.1.

Not all of these comments are necessarily relevant to the study at hand, yet they provide an important glimpse into some of the possibly dominant mindsets in the Renewable Energy and Development Industries in South Africa.

However, the importance of these findings in relation to the current study lies in the degree that they contribute towards answering the research questions stated in the introduction of this document. These constitute the main findings and will be listed and discussed in the following sub-section.

5.4. Main Findings

The study had two primary objectives:

- Identify an established framework for sustainable decision-making of rural energy in South Africa based on the literature.
- Determine the appropriateness of the identified established framework for the implementation of energy projects in the South African rural context.

The first objective was addressed, in part, by chapters two and three, since the frameworks that have been tested are a result of the literature study. The second objective, which concerns the appropriateness of the identified framework(s), was the reason for the Delphi study. To address the objective appropriately, there are 3 “sub-questions” that need to be answered by the results obtained from the study.

5.4.1. What are the main shortcomings of the frameworks?

The first possible shortcoming that has been identified concerns the practical executability of a number of the analyses and implementation methods, as has been mentioned in table 9. This refers specifically to the Community Action Plan, Baseline Analysis and Policy Environment Analysis, which have all three been mentioned by different parties as facing possible constraints due to a lack of money and/or time or merely an abundance of relevant information. However, even though these may not necessarily be considered practical in all contexts, the need for and importance of these analyses and methods are acknowledged.

Another big objection to the framework in general and definite areas within it in particular has been that it pre-supposes that renewable energy will be provided by state departments, para-statal, concessionaires and NGO's. This is in direct contrast with the market-led approach proposed by one of the participants, which is entirely led by individual supply-and-demand and other market forces.

This statement exposes what can be interpreted as a fundamentalist neo-liberal position when it comes to Renewable Energy provision that seeks to exclude the state from the market. This is substantiated by the relatively aggressive antagonism associated with most of these related responses. As was shown in the literature study, this perspective seems to be replaced in development circles by a more middle-ground type approach, which affords state, market and civil society each with their respective functions; the fact that this market fundamentalist position was constantly in the minority also supports this statement.

Apart from these, there do not seem to be other noteworthy shortcomings listed by the participants; the mentioned two seem to be the reasons behind most if not all of the objections in the Delphi study.

5.4.2. What are the main virtues of the frameworks?

The overall voting distribution of the Delphi study suggests that the frameworks are suited to the South African context, with a few possible additions/adjustments. The majority reaction to the frameworks, in both rounds of the surveys, has been overwhelmingly positive. Naturally, not all analysis methods proposed by the ITDG found enormous support, yet there was overwhelming support for all analyses suggested by the ITDG manual.

This support is also present for the methods proposed by both frameworks as well as most of the indicators proposed by the SURE decision support system. The output of the SURE-DSS has been mentioned a few times in particular due to the ease with which one is able to make comparisons between technologies. The all inclusive nature of the frameworks (as opposed to merely technology and/or financially based frameworks) also seems to have found favour with most respondents. There seems to exist a realisation in the industry that implementation in isolation of the end-users and natural environment is a treacherous exercise that has a very good chance of failure.

The consensus among the majority of the respondents therefore is that the proposed frameworks are very suited to the South African context in general and the needs in the Renewable Energy sector in particular.

5.4.3. Are there possible additions/adjustments?

Additions to the frameworks were proposed in two main sections: analysis methods and indicators.

With regards to analysis methods, only one additional analysis was proposed: Per Capita Income. The proposal was to include this analysis as part of the preparatory analyses, which will then serve to inform the viability of the project. This proposed analysis was tested in the second round and the results are tremendously favourable for its inclusion.

The financial indicators proposed by the SURE-DSS do not seem to be sufficient for the South African context and have been strengthened by the addition of the *Access to Micro-finance* and *Knowledge of/Experience with Co-operatives* indicators. These are especially relevant in South Africa due to the relative inaccessibility of the formal financial sector for the rural poor. The Natural Resources Indicators has seen the addition of the *Population Density* indicator as a possible “meta-indicator”, according to which the favourability of most natural resources can be assessed. The same can be said for the Human Resources Indicators, where the *Access to Clean Water* indicator also seems to be an important addition due to its ability to influence the other indicators in the section. All of these additional indicators were included and tested in the second round of the Delphi survey, with very favourable results as well.

Upon embarking on the analysis, there was quite a large amount of uncertainty as to whether the results of the study would confirm the salient points of the literature surrounding the matter. However, the results for the survey did not deliver any substantial surprises and to a large degree merely served to confirm the main observations of the literature review in the sense that the frameworks identified by the review were for the most part accepted by the majority of the participants. What this implies is one of the subjects that will be discussed in the following chapter.

An important interjection to this seemingly neat conclusion is the fact that the participant profile is skewed towards the private sector and technology supply. This has had a definite effect on the results: the most blatantly apparent example is the market-fundamentalist that to a large degree undermined much of the consensus around the framework. However, the remaining results are almost perplexing when one considers the fact that a very large percentage of their responses is in line with what is being propagated in rural renewable energy literature and public rhetoric. This is quite possibly the result of the fact that most large-scale renewable energy undertakings are funded and run by the state, NGO’s and/or other international organisations and is geared, especially in South Africa, towards development. Obviously then the logic that is being used in

those circles will have a significant effect on the suppliers as they are the one that need to cater to the demands of these “customers”. Also, the marketing and logic associated with renewable energy in general refers to the environmental impacts, global warming and development; this motivates not only the customers who buy the technology, but also those that decided to become involved in renewable energy through technology supply.

Still, most of the participants respond distinctly more confidently when it comes to issues of finance and technology. This is not at all surprising when one considers the fact that these are the two factors that most technology suppliers deal with on a day to day basis. Effectively, it is only the ones implementing and using the technology, which in a lot of cases are the clients of these technology suppliers, that are expected to take cognisance of the additional dimensions such as environmental, social and human resources.

This exposes a possible significant flaw in the South African renewable energy sector, where the private sector, which is to a large degree responsible for a lot of renewable energy research and development, is still designing systems with only financial and technological considerations in mind.

Chapter 6: Conclusion

From the lush grasslands of Kwazulu-Natal to the harsh semi-desert of the Northern Cape, rural poverty remains an important undeniable part of South African society. Energy, in all of its forms, is needed to enable those caught in this abyss to take their first few steps out of it. According to the literature review, though, the actual delivery of this energy to those most in need of it is a very complicated matter, more often than not leading to trust-shattering failures. Finding a solution to this problem of sustainable energy delivery has therefore been the main focus of this study. As such, the study provides a valuable and possibly lasting contribution to the fields of rural development and rural renewable energy.

The two identified frameworks have, according to this study, passed the applicability test with great success. Not only do they line up with the most authoritative studies on rural development and rural renewable energy, but they have also proven to be acceptable to experts within the renewable energy realm in South Africa.

From a sustainable development perspective, the frameworks are a big step in the direction of a sustainable future as they facilitate increased complexity, which, according to Gallopin (2003: 17 - 18) is the equivalent of sustainable development. Not only is this done through a technology neutral approach (which opens up a world of energy possibilities to the end-users), but the SURE decision support system is founded upon the Sustainable Livelihoods perspective, according to which the appropriateness of energy interventions is measured based on their effect on the five capitals of a community. The most appropriate energy option will obviously increase those capitals most important to the community, thereby increasing the number of options of the community; this again translates into increased complexity.

The Sustainable Livelihoods perspective, backbone of the decision-support system, is also impossible to use without proper participatory practises being in place. This can be found throughout the proposed frameworks, from the preparatory analysis through to the

monitoring and evaluation. The results of the Delphi study also reveal that interactive methods of analysis and information gathering were constantly among the highest scoring. The community-based decision-making, implementation and monitoring and evaluation methods proposed by the ITDG also received strong support from respondents, paving the way for social learning and empowerment through the delivery of energy to rural communities.

The interactive nature of the proposed methods also allow for easier technology transfer as knowledge of and experience with the proposed energy technologies increase through participation in all stages. The skills analysis proposed by the ITDG also significantly increases the chances of successful technology transfer in that, as was proposed by the respondents, it allows for decision-making around the technical maintenance ability of the community. Coupled with the community-based strategy development, the practise of successful technology transfer becomes much more of a tangible reality. This strategy, designed around the sustainable livelihood capitals and capital-needs of the community, is also key in enabling effective poverty reduction in the targeted communities.

The developers of the SURE decision support system argue that "...it is a valuable contribution to the project of bringing affordable, sustainable energy to poor rural communities in the developing world. This information can be crucial for a community searching for feasible solutions to concrete problems as well as for national government programmes targeting sustainable rural development in specific areas." (Cherni *et al.* 2007: 1502). The validity of this argument has increased as a result of this study, not only because of the fact that their model has achieved positive results from renewable energy experts in a developing country, but also because it has been combined with the Intermediate Technology Development Group's manual that allows for the utilization of the information provided by the SURE-DSS to create a robust, community-based implementation strategy.

Not that the two frameworks were accepted unanimously, or without reservations; the initial struggle that was mentioned in the literature review between the forces of the

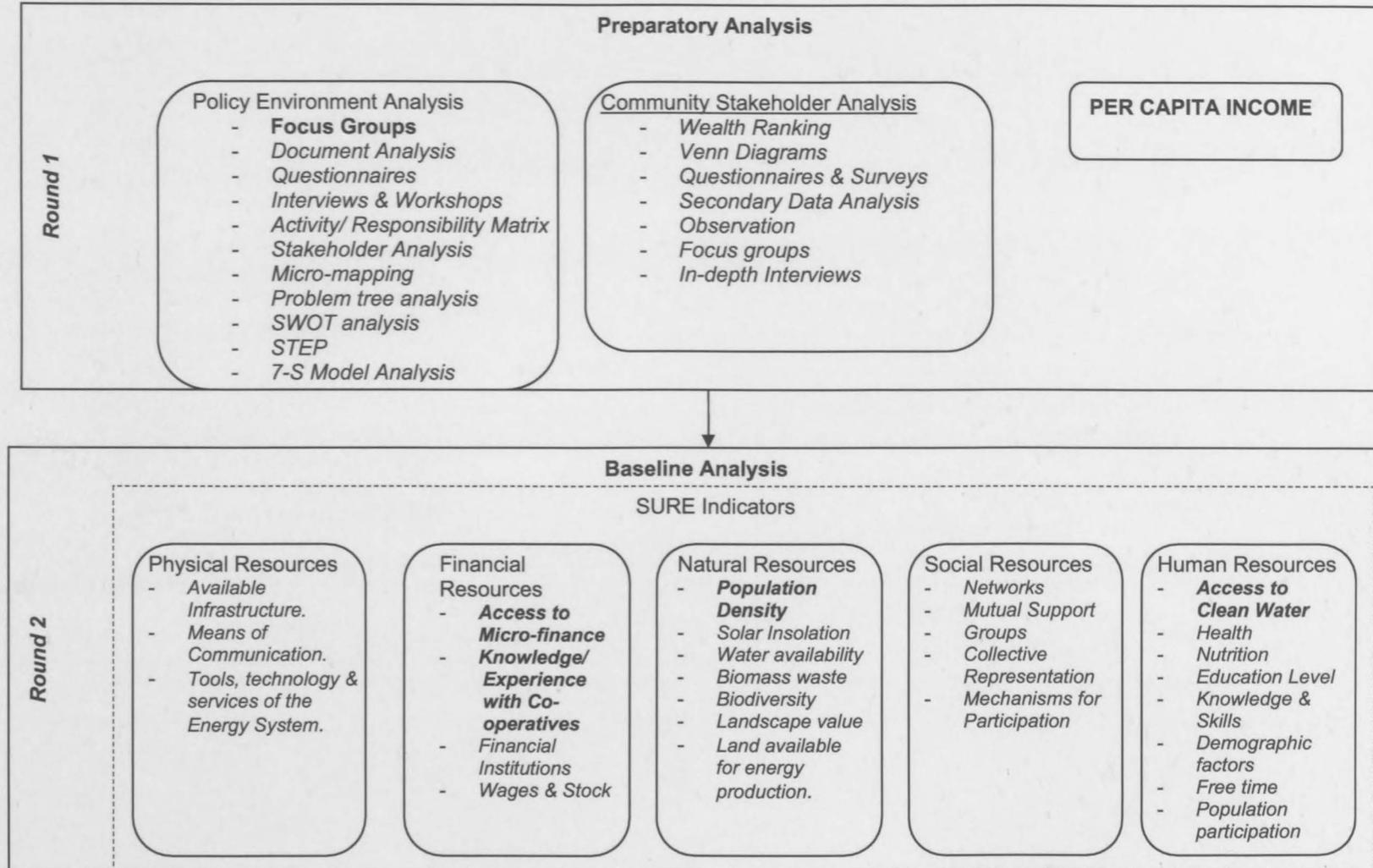
market and the state in development also played out in the results of the Delphi study, providing resistance that made up for what it lacked in numbers in intensity. Additionally, the use of experienced individuals did not rule out the need for practical testing, as was initially thought would be the case. Instead, reservations about the practical executability of a number of analyses and indicator-assessments merely served to prove that the frameworks definitely need to be tested through the use of case studies.

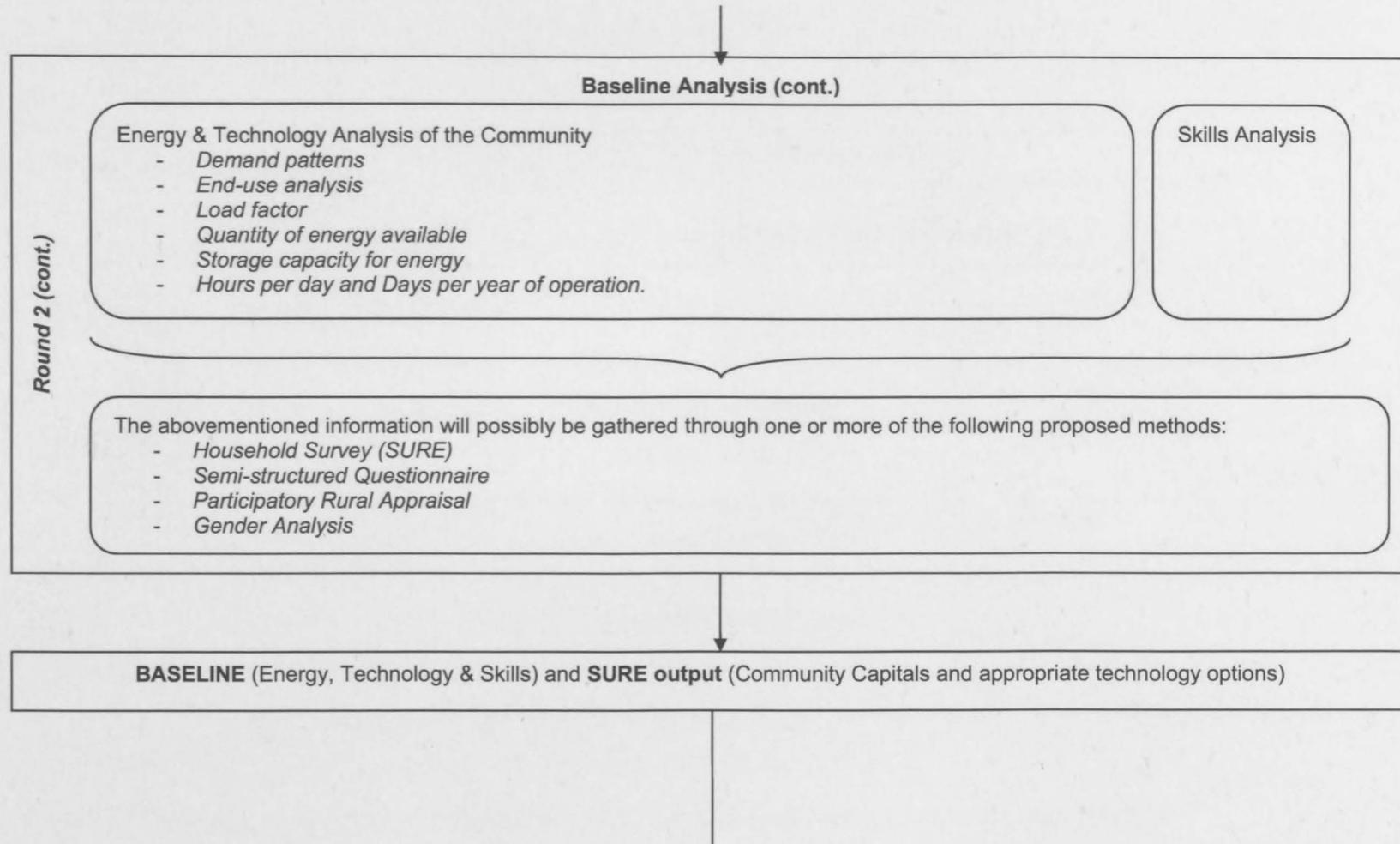
For the sake of clarity, 2 diagrams have been included in this final chapter: figure 6.1 is a round-by-round breakdown of the proposed sequential framework, much like figure 3.4, but with the important difference of the additional methods and indicators that were proposed by the respondents having been added. It is clear from figure 6.1 that there is very little that has been added to the framework, the most important additions being the proposed measure of *per capita income* as well as the indicators *Access to clean water*, *Population density* and *Access to Micro-finance*. The importance of these additions can be accredited to their inclusion in figure 6.2.

Figure 6.2 shows the integrated framework, with the priority indicators and methods also listed: these are the indicators and methods that scored above 65% in the second round of the Delphi study. As was mentioned at the end of the previous chapter, there seems to be a definite bias towards the economic and technological sectors of the framework: this is evident from the fact that both of these sectors have the largest number of appraisal methods that scored above 65%. *Energy Services & Technology Choice* is indeed the section with the highest amount of votes, with 6 methods scoring above 65%.

This results points towards a possible deficiency in terms of knowledge in the South African renewable energy sector concerning environmental and social/human issues. It seems that technological development and provision may mainly be governed by financial and technical issues, which does not necessarily make for holistic sustainable rural development driven by renewable energy.

These possible deficiencies point towards a deeper cause in the chain of technological development. It is therefore proposed that this deficiency in the renewable energy sector be addressed through the introduction of the sustainable development concept and sustainability science into the arena of technology design and management, especially as it relates to renewable energy.





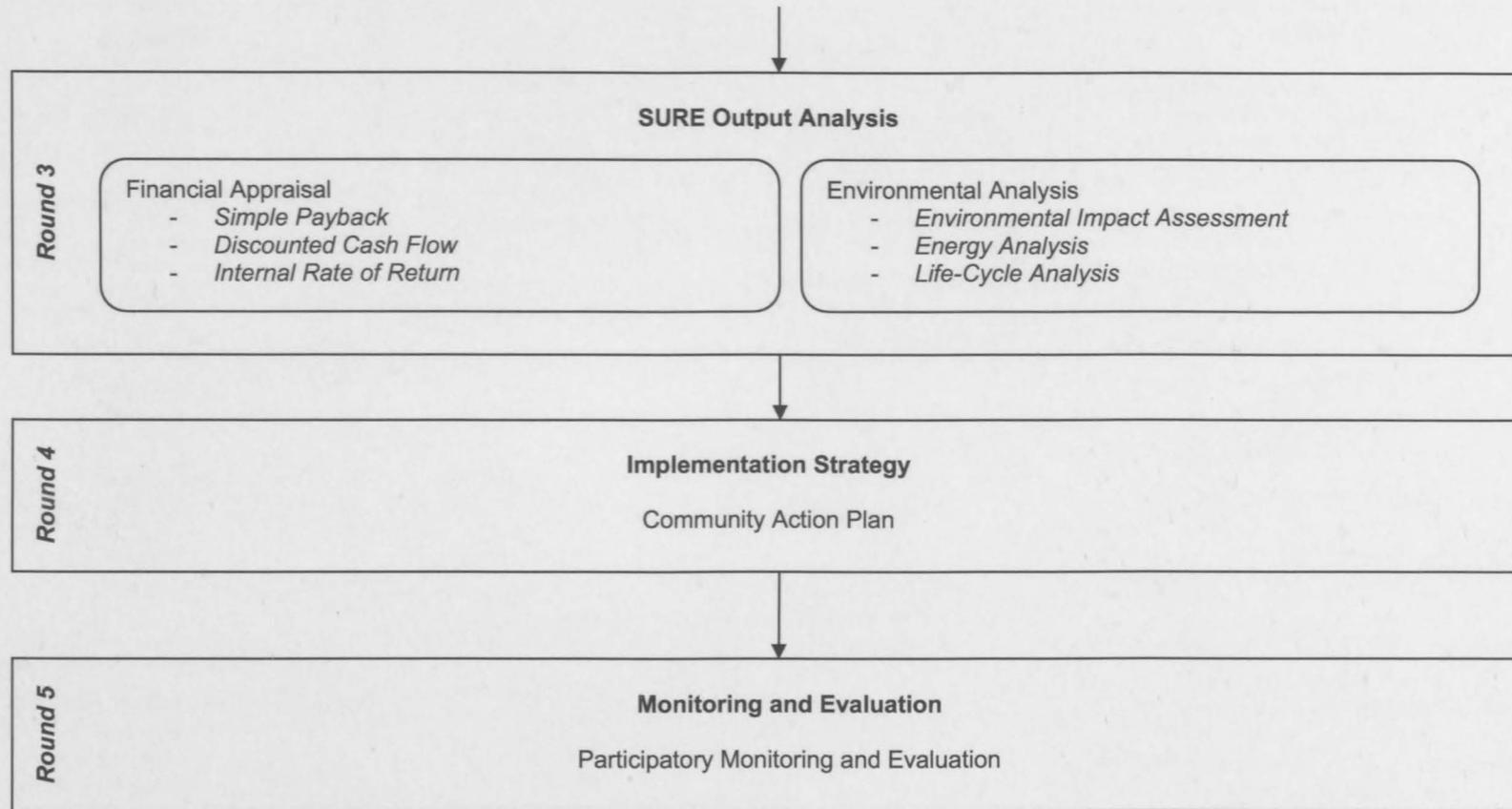


Figure 6.1: Round-by-round breakdown of the framework with additional methods/indicators highlighted

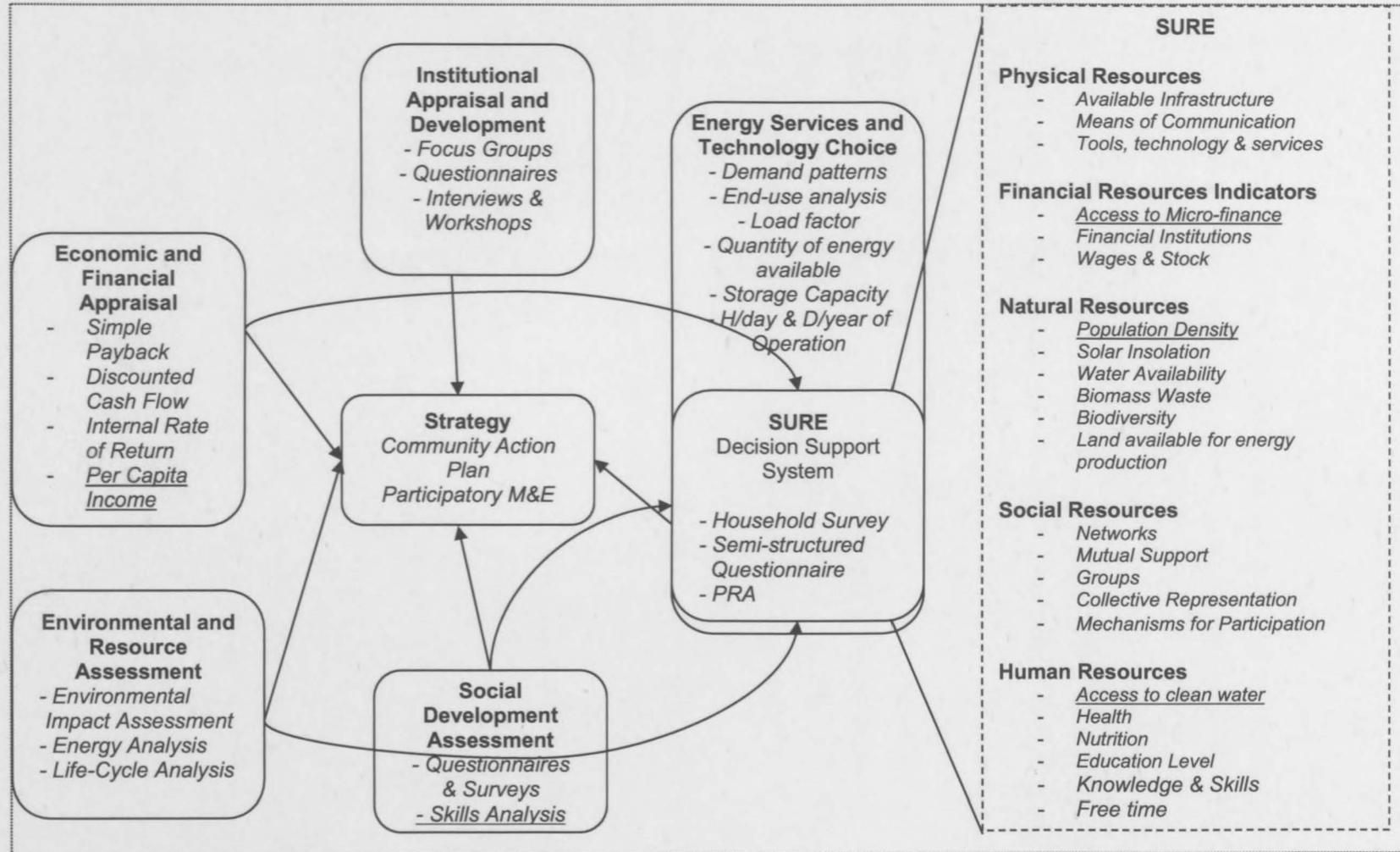


Figure 6.2: Integrated framework with priority indicators and methods

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Appendix A: Survey Document Round 1

Rural Renewable Energy Delphi study

1. INTRODUCTION

Before you proceed to fill out the questionnaire, please take a moment to read the following and become acquainted with the context of the study

This Delphi study forms part of an MPhil study in Renewable and Sustainable Energy, with the particular aim of proposing and testing an integrated framework for the evaluation and implementation of rural renewable energy projects in South Africa.

You have been chosen to participate in the evaluation of the framework because of your experience in the management of rural renewable energy projects in South Africa.

The aim of this questionnaire is to test the framework and should take you approximately 25 minutes to complete.

Please see the "Background to survey" document attached to your e-mail for a more thorough explanation of the context of and reasoning behind the survey.

There are two established frameworks for decision support and strategy development for rural renewable energy (Mulugetta et al., 2005; Cherni et al., 2007).

- a) The Intermediate Technology Development Group (ITDG) describes the framework via a manual (guideline document) on how to establish the social, institutional, technological (technical), financial and environmental frameworks of a renewable energy project execution.
- b) The Renewable Energy for Sustainable Rural Livelihoods framework (Cherni et al, 2007) assesses the 5 capitals (human, social, physical, natural, financial) associated with the Sustainable Livelihoods approach (see "Sustainable Livelihoods" document attached to your e-mail), and impacts of important up-to-date energy technologies (put in ref of what a technology is). To do this, Cherni et al (2007) have developed a computerized decision support system that uses a great deal of information on the capitals available to a community and presents the best technology choices in terms of the impacts on these capitals.

These 2 frameworks have been integrated (see the "Background to survey" document attached to you e-mail), with the aim of enhancing the complementary features of each. What this survey therefore tests, is the applicability of this integrated framework for the South African context.

The survey has been divided into the 4 parts of a project cycle: Preparatory Assessment, Baseline Assessment, Planning & Implementation and Monitoring & Evaluation.

For any queries on the survey or project, please feel free to contact me (Wikus Kruger) at: 072 379 1738 or 14086263@sun.ac.za.

Thank you very much

You may now proceed to fill out the remainder of the questionnaire.

1. Please indicate whether you agree to participate in this study.

- I understand that the information I provide will be handled confidentially, although the results of this study may be published, and agree to participate in the study
- I do not agree to participate

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2. DEMOGRAPHIC INFORMATION

1. You will remain anonymous to the other members of the delphi-group. However, your identity will be known to the researcher.

Name: _____
Company: _____
Address: _____
Address 2: _____
City/Town: _____
State/Province: _____
ZIP/Postal Code: _____
Country: _____

2. E-mail address:

3. What is your highest qualification?

4. What type of organisation do you work for?

Government
 NGO
 Private sector
 Para-statal
Other (please specify)

5. How long have you been involved rural Renewable Energy in South Africa?

6. Previous field worked in prior to Renewable Energy?

7. Aspects of Renewable Energy in which you are involved?

8. Where in South Africa do you mainly implement rural energy?

Rural Renewable Energy Delphi study

3. PREPARATORY ANALYSIS

The questions on this page relate to the preparatory analyses, i.e. the analysis that needs to be done before starting the project at the community level. The steps/questions are not necessarily in chronological order.

Experience has shown that benefits are only sustained when hardware installation is fully integrated with properly planned and implemented operation, maintenance and financing instruments.

As a result, the authors of the ITDG manual propose a Policy Environment Appraisal as well as a Community Stakeholder Analysis.

(Mulugetta et al., 2005: 101 - 110)

1. POLICY ENVIRONMENT ANALYSIS

The Policy Environment represents the broad context within which development takes place, and can be either an enabling or constraining factor. An understanding of the policy environment would yield information on the impact of policies on livelihoods and help in defining appropriate policy options. A POLICY ENVIRONMENT ANALYSIS allows one to gather and critically analyze information on the policies relevant to your work.

Do you think that this is a necessary step? Please justify your answer.

- 1. Definitely Yes
- 2. Possibly Yes
- 3. Possibly No
- 4. Definitely No
- I don't know

Why?

2. POLICY ENVIRONMENT ANALYSIS

If your answer is not "Definitely No", please indicate the methods that you would use to carry out this analysis. If you feel that there are additional methods that you would use, or you feel that none of the supplied methods are appropriate, please name and describe the methods you would add in the comment box.

- Document analysis (government policy documents, ministerial directives, memos, draft papers, statements from key decision makers)
- Questionnaires (To gain a broad picture of people's views on policy matters)
- Interviews and Workshops (when details of the policy context and processes, and their impact on the ground are not clear, interviews and workshops can be conducted with key informants, such as those making and influencing policy as well as those impacted by policy)
- Activity/Responsibility Matrix (Institutional responsibility assessment)
- Stakeholder analysis (identify and assess the importance and interests of key people, groups or institutions that have an impact on policy or are influenced by policy)
- Micro-mapping (evaluates intra-sectoral support for new policies and ideas, how certain sectors will react)
- Problem tree analysis (helps to illustrate the linkages between a set of complex issues or relationships by fitting them into a hierarchy of related factors)
- SWOT Analysis (Used to identify Strengths, Weaknesses, Opportunities, Threats in relation to the strategic planning of an organisation or a particular reform option)
- STEP (Social, Technological, Economic, Political) Analysis (used to scan the external macro-environment in which an organisation operates and complements SWOT analysis)
- 7-S model Analysis (Shared values, strategy, structure, systems, skills, style, staff are key mutually dependent organisational variables that need to be taken into consideration in effecting organisational change)

Rural Renewable Energy Delphi study

None of the above
 Other (please specify) _____

3. COMMUNITY STAKEHOLDER ANALYSIS

A stakeholder analysis can be used to identify individuals, groups, communities or institutions that are likely to be affected by, or can have an influence on, the outcome of a project or program (ODA, 1995). A community stakeholder analysis is focused specifically on the community affected by the energy project.

Steps involved in a community stakeholder analysis:

- 1. Identify the main stakeholders**
- 2. Assess stakeholder interest and impact of the project**
- 3. Determine stakeholder influence and importance**
- 4. Outline a stakeholder participation strategy**

Would you carry out a community stakeholder analysis? Please justify your answer in the comment box.

1. Definitely Yes
 2. Possibly Yes
 3. Possibly No
 4. Definitely No
 I don't know

Why? _____

4. COMMUNITY STAKEHOLDER ANALYSIS

If you did not answer "Definitely No" to the previous question, please tick off the methods that you would propose for doing a community stakeholder analysis.

Wealth Ranking (Assigning households to well being categories)
 Venn Diagrams (Diagrammatic representation of key institutional interactions)
 Questionnaires & Surveys
 Secondary Data Analysis
 Observation
 Focus Groups
 In-depth Interviews
 None of the above
 Other (please specify) _____

Rural Renewable Energy Delphi study

4. BASELINE ANALYSIS

The aim of this section is to evaluate the type of information needed for a baseline analysis of the community, the methods needed for the gathering of this information as well as the assessment of the overall necessity of a baseline analysis.

1. A baseline analysis simply involves describing and quantifying in detail the physical, biological, social and economic conditions in the area that may be affected due to the project, and serves primarily as a benchmark for the future.

Do you think that a baseline analysis of the community is necessary? Please justify your answer.

1. Definitely Yes
 I don't know
 2. Possibly Yes
 3. Possibly No
 4. Definitely No

Why?

**2. COMMUNITY RESOURCES/CAPITALS**

The SURE (Sustainable Rural Energy) decision support system makes use of the Sustainable Livelihoods approach and therefore has to be "fed" with information concerning the current status of these different capitals. The following questions will thus assess the appropriateness of the indicators chosen to evaluate these questions. What is required of you in each case is to tick off the indicators if you think they are appropriate. If you think that there are indicators that should be added, please name and describe them in the comment box. The first resource or capital indicator to be assessed, is:

Physical Resources Indicator

This refers to the community's basic infrastructure (Ashley and Carney, 1999; DfID, 2000). More precisely, physical capital refers to producer goods, such as buildings, roads, machinery and electricity that may generate a future flow of output; as all are important for energy development. The formula for the physical resource indicator is:

$$PR = In + Co + TT$$

Where PR stands for Physical Resources,
 IN is the available infrastructure in the community,
 Co is the available means of communication and
 TT is the tools, technology and services of the energy system.

Please select the following indicators if you think they are appropriate. Please also justify your answer(s).

- Available Infrastructure
 Means of Communication

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Tools, technology and services of the energy system

None of the above

Additional indicators/Justification

3. Financial Resources Indicator

The community will require the financial means to purchase the equipment and ensure its maintenance. The financial indicator therefore shows what facilities a population has to obtain funds and what sources of income are available:

FER = FI + WS

Where FI are the financial institutions accessible to the community and WS are the wages earned by the community and the stock they have to sell.

Are the following indicators appropriate (please select the indicator if you agree) and, if you think there are additional indicators that need to be used, please name and describe them in the comment box. Please also justify your answer(s).

Financial Institutions

Wages and Stock

None of the above

I don't know

Additional Indicators/Justification

4. Natural Resources Indicator

This refers to the natural resource that are accessible to households or individuals within their rural context from which resource flows useful for livelihoods can be derived (Carney et al., 1999; DfID, 2000). Natural resources are considered as both a source for energy and for the environmental impact of energy technologies:

NR = S = Wa + Wi + Ws + Biod + LV + Le

Where S is the Solar insolation (a measure of solar radiation energy incident on a surface, measured in kilowatt-hours per square meters),

Wa is water availability,

Wi is wind availability,

Ws is biomass waste,

Biod is the biodiversity,

LV is the landscape value and

Le is the land available for energy production.

Are the following indicators appropriate (please select the indicator if you agree) and, if you think there are additional indicators that need to be used,

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please name and describe them in the comment box. Please also justify your answer(s).

Solar Insolation
 Water Availability
 Biomass Waste
 Biodiversity
 Landscape Value
 Land available for Energy Production
 None of the above
 I don't know

Additional indicators/Justification

5. Social Resources Indicator

Social assets or social capital refers to community and wider social claims on which individuals and households can draw in the pursuit of livelihoods by virtue of their belonging to different social groups (Ellis, 2000; DfID, 2000). This category of asset is meant to capture the reciprocal relations within communities and between households based on trust deriving from social ties (Moser, 1998) particularly because these may be affected by the presence or the lack of energy. Political association is a further variable incorporated by RESURL and it exists by virtue of people's affiliation, favouratism or political interests. The social resource indicator is calculated in the following manner:

SR = N + Ms + LO + MP

Where N is networks,
 Ms is mutual support,
 G is groups,
 CR is collective representation and
 MR is mechanisms for participation.

Are the following indicators appropriate (please select the indicator if you agree) and, if you think there are additional indicators that need to be used, please name and describe them in the comment box. Please also justify your answer(s).

Networks
 Mutual Support
 Groups
 Collective Representation
 Mechanisms for Participation
 None of the above
 I don't know

Additional indicators/Justification

6. Human Resources Indicator

Rural Renewable Energy Delphi study

Human Resources refer to the qualities that can be improved, or otherwise, by the provision of energy.

$$HR = H + N + AW + Ed + Ks + D + FT + PP$$

- Where H is health,**
- N is nutrition,**
- AW is access to clean water,**
- Ed is education level,**
- Ks is knowledge and skills,**
- D is demographic factors,**
- FT is free time and**
- PP population participation.**

Are the following indicators appropriate (please select the indicator if you agree) and, if you think there are additional indicators that need to be used, please name and describe them in the comment box. Please also justify your answer(s).

- Health
- Nutrition
- Education Level
- Knowledge and Skills
- Demographic Factors
- Free Time
- Population Participation
- None of the above
- I don't know

Additional Indicators/Justification

7. ENERGY & TECHNOLOGY ANALYSIS

To establish the baseline status of current energy and technology in the community, there are a number of methods that can be used. The methods are described shortly below:

ASSESSMENT OF DEMAND PATTERNS

The demand assessment should identify the times at which energy is required and the quantity required by the user as well as the trend of future energy demand... the exercise should be inclusive so as to evaluate energy needs of poor and marginalized groups. The use of an energy service survey may very well provide the information needed.

END-USE ANALYSIS

Once the priority end-uses are identified... it is necessary to know how much energy is needed to produce particular goods and services at various stages of

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the energy chain, from primary energy production down to the provision of useful energy.

LOAD FACTOR

Load factor is the ratio of actual energy used to the total energy that would be delivered if the system operated continuously. Knowledge of the load factor provides information about the extent to which a given energy technology is actually exploited to for profitable use and is a good indicator of the financial viability of the system.

ENERGY SUPPLY AND AVAILABILITY PATTERNS

The supply and availability pattern of a technology is determined by a number of loosely connected technical considerations:

- Quantity of energy available
- Energy storage capacity
- Hours per day and days per year of operation

Please indicate which methods (if any) you regard as appropriate by selecting them. If there are additional methods you would propose, please name and describe them. Please also justify your answer(s).

- Demand patterns
- End-use Analysis
- Load Factor
- Quantity of Energy available
- Storage Capacity for Energy
- Hours per day and Days per year of operation
- None of the above
- I don't know

Additional Methods/Justification

8. SKILLS ANALYSIS

Do you think that a skills analysis is necessary? Please qualify your answer.

- 1. Definitely Yes
- 2. Possibly Yes
- 3. Possibly No
- 4. Definitely No
- I don't know

Comment

9. INFORMATION GATHERING

Rural Renewable Energy Delphi study

Below are brief explanatory descriptions of the methods proposed for gathering information for the baseline analysis:

HOUSEHOLD SURVEY

This is a standardised survey created by RESURL, with the aim of gathering results on the indicators used in the SURE decision support system.

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PRA is a rapid means of carrying out social analysis that permits the analysis of "social impact"...it draws on an array of participatory oriented traditions whereby local people are not only providers of information, but also determine what the important issues are, the methods employed to get information and to participate in the use of the information. A sense of ownership is created.

(Mulugetta et. al., 2005: 39 – 43)

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Gender analysis is a term used to describe both the information gathered on gender in a community as well as the methods used to gather it. In this context, the term is used to describe the information gathering method.

It is defined as "...the range of methods used to understand and document the relationships between men and women, their access to resources, their activities and constraints they face as a function of their sexual category... gender analysis can inform the way in which women and men engage in planning, implementation and monitoring of projects...

(Mulugetta et. al., 2005: 43 – 47)

Please select which of the following methods you would recommend for the gathering of the abovementioned information.

If there are additional methods that you think should be used to gather this information, please name and describe them in the comment box. Please also justify your answer(s).

- Household Survey
- Semi-structured Questionnaire
- Participatory Rural Appraisal
- Gender Analysis
- Other

Rural Renewable Energy Delphi study

Additional Methods/Justification



5. ANALYSIS AND DECISION SUPPORT

The questions in this chapter are used to test the output delivered by the SURE decision support system as well as to determine what additional analyses are necessary to deliver appropriate technology options.

The software of SURE processes the information using the Compromise Programming Multi-criteria Method of Yu (1973) and Zeleny (1973). With the information gathered, the SURE-DSS makes use of the following mathematical functions to calculate the appropriate different options:

$$(C_j, j = 1, \dots, 5)$$

$$C_j(A_i) \frac{1}{1 + e^{-M_j X_j(A_j)}}, (j = 1, \dots, 5; i = 1, \dots, n)$$

Where $C_j(A_i)$ represents the evaluation of the i -th energy alternative ($A_i, i = 1, \dots, n$) against the resource $j, j = 1, 2, \dots, 5$, (1 indicates Natural, 2 Physical, 3 Social, 4 Human and 5

Financial); $X_j(A_i)$ represents the effects of the i -th energy alternative on the corresponding community's resource j ; and M_j is a scale parameter, associated to the

number of factors that compose each resource j .

$$M_j = (20 * (X_j - a) / (b - a)) - 10$$

Where a is the lower limit of the X_j range of values; and b is the upper limit of the X_j range of values.

The result of this analysis is a graphical depiction of the different options in the form of a pentagon, based on the 5 capitals used in the Sustainable Livelihoods approach. This pentagon's outer limits depict the ideal state of the community. The pentagon also shows the baseline of the community (before) as well as the effect that the different energy technologies are projected to have (after).

As the developers of SURE put it:

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alternative livelihoods with different energy solutions. The underlying goal of minimising the gap between the maximum possible value $\delta \frac{1}{4} 1P$ for each asset (a theoretical state) of greatest development and the real value that it could achieve through the application of an energy technology is illustrated

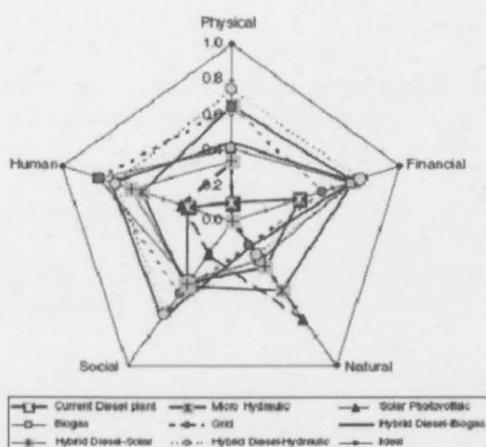


Fig. 3. The impact of energy technologies within the framework of sustainable livelihoods, San José de Cravo Norte II, Colombia, 2003

Table 4
Scores for most appropriate technology options, SICN II, 2003

Solution number	Energy technologies	Score of appropriateness*
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5	Hybrid diesel-biogas	0.6
6	Hybrid diesel-solar	0.4
7	Diesel plant	0.1
8	Solar photovoltaic	0.0

*The larger the score, the most appropriate the technology.

1. Do you find the output of the SURE decision support system helpful, i.e. would you like to use it yourself? Please qualify your answer.

- 1. Definitely Yes
- 2. Possibly Yes
- 3. Possibly No
- 4. Definitely No
- I don't know

Why?

2. Below is a list and descriptions of financial appraisal methods propagated by

**Rural Renewable Energy Delphi study
the ITDG manual:**

SIMPLE PAYBACK

The simple payback time is the period, usually expressed in years, within which the initial investment is completely recovered.

$$P=C/(b-c)$$

Where P is the simple payback time, C the total capital cost of the project, b the projected annual benefits and c the projected annual running costs.

DISCOUNTED CASH FLOW ANALYSIS (a.k.a. Net Present Value)

... (discounted cash flow analysis) relies heavily on the principle of discounting future costs and benefits so as to represent them in terms of their present value.

INTERNAL RATE OF RETURN

The internal rate of return (IRR) on project X is defined as the discount rate r at which $NPV(X,r) = 0$.

THE GENERATION COST (This is the method used by SURE)

The generation cost methodology is a further variation of discounted cash flow analysis...the generation cost method provides a rather straightforward way of comparing the financial costs of different electricity generating options.

Please select which method(s), if any, you would use in addition to the generation cost method used by SURE, to evaluate the output delivered by SURE. If there are additional methods you would propose, please name and describe them. Please justify your answer.

- Simple Payback
 Discounted Cash Flow
 Internal Rate of Return
 None
 I don't know

Other (please specify)/Justification

3. ENVIRONMENTAL ANALYSIS

Below is a descriptive list of environmental impact analysis methods proposed by the ITDG:

Rural Renewable Energy Delphi study

ENVIRONMENTAL IMPACT ASSESSMENT (USED BY SURE)

In rural energy projects, the role of EIA is to provide information to stakeholders and other concerned parties about the impact of the project on the environment, both human and natural.

ENERGY ANALYSIS

Energy Analysis is used to calculate all the energy inputs per unit of output of a product, process or system. It is important for the determining the viability of energy systems from a resource perspective and can also be used to calculate the energy payback time.

LIFE-CYCLE ANALYSIS

Life-cycle analysis goes farther than energy analysis in that it looks at all the impacts (not just energy) of all the components of a product over its lifetime.

Please select the method(s) that you would propose. If there are additional methods, please name and describe them. Also please justify your answer.

Environmental Impact Assessment (EIA)

Energy Analysis

Life-Cycle Analysis

None

I don't know

Other (please specify)/Justification



6. IMPLEMENTATION STRATEGY

This page will assess the appropriateness of the implementation strategy proposed by the ITDG manual.

1. The ITDG manual proposes a Community Action Plan (CAP) to effect implementation.

A CAP is a process which enables communities to design, implement and manage their own programme or project. The action plan is developed in an intensive workshop, which is participatory, community-based and problem-driven. The development plan is outlined through a process of problem prioritization and formulation of strategies and options for dealing with the problems. Central to the method is the setting up of partnerships between local people and the project staff in a mutual learning process of dialogue, negotiation and decision-making. The CAP can be complemented by diagnostic tools such as Stakeholder Analysis or PRA to identify the main actors and the principal problems.

The stages of a CAP process are:

- § 1. Problem identification and prioritizing
- § 2. Consider alternative courses of action
- § 3. Identify the tasks and the retrospective actors involved
- § 4. Identify gaps and weak linkages
- § 5. Agreement on coordination mechanisms
- § 6. Agreement on indicators and monitoring mechanisms

(Mulugetta et. al., 2005: 47 – 49)

Would you make use of this method? If not, please name and describe what methods you would propose. Also please justify your answer.

- 1. Definitely Yes
- 2. Possibly Yes
- 3. Possibly No
- 4. Definitely No
- I don't know

Other (please specify)/Justification



Rural Renewable Energy Delphi study

7. MONITORING & EVALUATION

This page aims to evaluate the appropriateness of the Monitoring and Evaluation methods proposed by the ITDG Manual.

1. The ITDG manual proposes the use of Participatory Monitoring and Evaluation (PM&E):

PM&E is a process of self-assessment, knowledge generation, and collective action in which stakeholders in a programme or intervention collaboratively define the evaluation issues, collect and analyse data and take corrective action as a result of what they learn through this process.

The stakeholders usually involved in PM&E activity include the end-users of project goods and services, intermediary organizations such as NGOs, private sector business and government staff at various levels.

The fundamental processes of PM&E are as follows:

- § Establish framework
- § Identify indicators to be used
- § Gather the data
- § Analyze
- § Agree on findings and what to do next

Would you also propose the use of PM&E? Please name and describe any other methods that you would propose. Please also justify your answer.

- 1. Definitely Yes
- 2. Possibly Yes
- 3. Possibly No
- 4. Definitely No
- I don't know

Other (please specify)/Justification

Appendix B: Survey Document Round 2

Rural RE Delphi: Round 2

1. INTRODUCTION

Please read through the following section. This should enlighten you as to the purpose and procedure of the second round of the survey.

Although this is the second round of the online Delphi Survey, very little is different from the first round: the same documents are still relevant for this round. The format remains the same, as do most of the response options.

New response options will be indicated in capital letters.

The aim of this survey is to test the stability of the responses of the first round. Therefore it is imperative that the **WHOLE** questionnaire be filled out again. Since you are already acquainted with most of the questions and response options, it should take a much shorter amount of time than the first round.

More than 80% of the group hail from the private sector; the rest hail from para-statal.

For any queries on the survey or project, please feel free to contact me (Wikus Kruger) at: 072 379 1738 or 14086263@sun.ac.za.

Thank you very much

You may now proceed to fill out the remainder of the questionnaire.

1. Please indicate whether you agree to participate in this study.

- I understand that the information I provide will be handled confidentially, although the results of this study may be published, and agree to participate in the study
- I do not agree to participate

2. DEMOGRAPHIC INFORMATION

PLEASE FILL IN YOUR NAME AND SURNAME. YOU ARE WELCOME TO SKIP THE ADDITIONAL DEMOGRAPHIC QUESTIONS.

1. You will remain anonymous to the other members of the delphi-group. However, your identity will be known to the researcher.

Name:

Company:

Address:

Address 2:

City/Town:

State/Province:

ZIP/Postal Code:

Country:

2. E-mail address:

3. What is your highest qualification?

4. What type of organisation do you work for?

- Government
- NGO

Rural RE Delphi: Round 2

- Private sector
- Para-statal
- Other (please specify) _____

5. How long have you been involved rural Renewable Energy in South Africa?

6. Previous field worked in prior to Renewable Energy?

7. Aspects of Renewable Energy in which you are involved?

8. Where in South Africa do you mainly implement rural energy?

3. PREPARATORY ANALYSIS

The questions on this page relate to the preparatory analyses, i.e. the analysis that needs to be done before starting the project at the community level. The steps/questions are not necessarily in chronological order.

Experience has shown that benefits are only sustained when hardware installation is fully integrated with properly planned and implemented operation, maintenance and financing instruments.

As a result, the authors of the ITDG manual propose a Policy Environment Appraisal as well as a Community Stakeholder Analysis.

(Mulugetta et al., 2005: 101 - 110)

1. POLICY ENVIRONMENT ANALYSIS

The Policy Environment represents the broad context within which development takes place, and can be either an enabling or constraining factor. An understanding of the policy environment would yield information on the impact of policies on livelihoods and help in defining appropriate policy options. A POLICY ENVIRONMENT ANALYSIS allows one to gather and critically analyze information on the policies relevant to your work.

Do you think that this is a necessary step? Please justify your answer.

- 1. Definitely Yes
- 2. Possibly Yes
- 3. Possibly No
- 4. Definitely No
- I don't know

Why?

Rural RE Delphi: Round 2

2. POLICY ENVIRONMENT ANALYSIS

If your answer is not "Definitely No", please indicate the methods that you would use to carry out this analysis. If you feel that there are additional methods that you would use, or you feel that none of the supplied methods are appropriate, please name and describe the methods you would add in the comment box.

- FOCUS GROUPS
 - Document analysis (government policy documents, ministerial directives, memos, draft papers, statements from key decision makers)
 - Questionnaires (To gain a broad picture of people's views on policy matters)
 - Interviews and Workshops (when details of the policy context and processes, and their impact on the ground are not clear, interviews and workshops can be conducted with key informants, such as those making and influencing policy as well as those impacted by policy)
 - Activity/Responsibility Matrix (Institutional responsibility assessment)
 - Stakeholder analysis (identify and assess the importance and interests of key people, groups or institutions that have an impact on policy or are influenced by policy)
 - Micro-mapping (evaluates intra-sectoral support for new policies and ideas, how certain sectors will react)
 - Problem tree analysis (helps to illustrate the linkages between a set of complex issues or relationships by fitting them into a hierarchy of related factors)
 - SWOT Analysis (Used to identify Strengths, Weaknesses, Opportunities, Threats in relation to the strategic planning of an organisation or a particular reform option)
 - STEP (Social, Technological, Economic, Political) Analysis (used to scan the external macro-environment in which an organisation operates and complements SWOT analysis)
 - 7-S model Analysis (Shared values, strategy, structure, systems, skills, style, staff are key mutually dependent organisational variables that need to be taken into consideration in effecting organisational change)
 - None of the above
- Other (please specify) ▲
▼

3. COMMUNITY STAKEHOLDER ANALYSIS

A stakeholder analysis can be used to identify individuals, groups, communities or institutions that are likely to be affected by, or can have an influence on, the outcome of a project or program (ODA, 1995). A community stakeholder analysis is focused specifically on the community affected by the energy project.

Steps involved in a community stakeholder analysis:

1. Identify the main stakeholders
2. Assess stakeholder interest and impact of the project
3. Determine stakeholder influence and importance
4. Outline a stakeholder participation strategy

Would you carry out a community stakeholder analysis? Please justify your answer in the comment box.

- 1. Definitely Yes
- 2. Possibly Yes
- 3. Possibly No
- 4. Definitely No
- I don't know

Why?

_____ ▲
▼

Rural RE Delphi: Round 2

4. COMMUNITY STAKEHOLDER ANALYSIS

If you did not answer "Definitely No" to the previous question, please tick off the methods that you would propose for doing a community stakeholder analysis.

- Wealth Ranking (Assigning households to well being categories)
- Venn Diagrams (Diagrammatic representation of key institutional interactions)
- Questionnaires & Surveys
- Secondary Data Analysis
- Observation
- Focus Groups
- In-depth Interviews
- None of the above
- Other (please specify)



5. PER CAPITA INCOME

Do you think that it is necessary to determine the average per capita income of the community as part of the preparatory analysis?

- Definitely Yes
- Definitely No
- Possibly No
- Definitely No
- I don't know

Comment



Rural RE Delphi: Round 2

4. BASELINE ANALYSIS

The aim of this section is to evaluate the type of information needed for a baseline analysis of the community, the methods needed for the gathering of this information as well as the assessment of the overall necessity of a baseline analysis.

1. A baseline analysis simply involves describing and quantifying in detail the physical, biological, social and economic conditions in the area that may be affected due to the project, and serves primarily as a benchmark for the future.

Do you think that a baseline analysis of the community is necessary? Please justify your answer.

1. Definitely Yes
 I don't know
 2. Possibly Yes
 3. Possibly No
 4. Definitely No

Why?

2. COMMUNITY RESOURCES/CAPITALS

The SURE (Sustainable Rural Energy) decision support system makes use of the Sustainable Livelihoods approach and therefore has to be "fed" with information concerning the current status of these different capitals. The following questions will thus assess the appropriateness of the indicators chosen to evaluate these questions. What is required of you in each case is to tick off the indicators if you think they are appropriate. If you think that there are indicators that should be added, please name and describe them in the comment box. The first resource or capital indicator to be assessed, is:

Physical Resources Indicator

This refers to the community's basic infrastructure (Ashley and Carney, 1999; DfID, 2000). More precisely, physical capital refers to producer goods, such as buildings, roads, machinery and electricity that may generate a future flow of output; as all are important for energy development. The formula for the physical resource indicator is:

$$PR = In + Co + TT$$

Where PR stands for Physical Resources,
 IN is the available infrastructure in the community,
 Co is the available means of communication and
 TT is the tools, technology and services of the energy system.

Please select the following indicators if you think they are appropriate. Please also justify your answer(s).

- Available Infrastructure
 Means of Communication

Rural RE Delphi: Round 2

Tools, technology and services of the energy system
 None of the above
 Additional indicators/Justification

3. Financial Resources Indicator

The community will require the financial means to purchase the equipment and ensure its maintenance. The financial indicator therefore shows what facilities a population has to obtain funds and what sources of income are available:

FER = FI + WS

Where **FI** are the financial institutions accessible to the community and **WS** are the wages earned by the community and the stock they have to sell.

Are the following indicators appropriate (please select the indicator if you agree) and, if you think there are additional indicators that need to be used, please name and describe them in the comment box. Please also justify your answer(s).

ACCESS TO MICRO-FINANCE
 KNOWLEDGE/EXPERIENCE WITH CO-OPERATIVES
 Financial Institutions
 Wages and Stock
 None of the above
 I don't know
 Additional Indicators/Justification

4. Natural Resources Indicator

This refers to the natural resource that are accessible to households or individuals within their rural context from which resource flows useful for livelihoods can be derived (Carney et al., 1999; DfID, 2000). Natural resources are considered as both a source for energy and for the environmental impact of energy technologies:

NR = S = Wa + Wi + Ws + Biod + LV + Le

Where **S** is the Solar insolation (a measure of solar radiation energy incident on a surface, measured in kilowatt-hours per square meters),
Wa is water availability,
Wi is wind availability,
Ws is biomass waste,
Biod is the biodiversity,
LV is the landscape value and
Le is the land available for energy production.

Rural RE Delphi: Round 2

Are the following indicators appropriate (please select the indicator if you agree) and, if you think there are additional indicators that need to be used, please name and describe them in the comment box. Please also justify your answer(s).

POPULATION DENSITY
 Solar Insolation
 Water Availability
 Biomass Waste
 Biodiversity
 Landscape Value
 Land available for Energy Production
 None of the above
 I don't know

Additional indicators/Justification

5. Social Resources Indicator

Social assets or social capital refers to community and wider social claims on which individuals and households can draw in the pursuit of livelihoods by virtue of their belonging to different social groups (Ellis, 2000; DfID, 2000). This category of asset is meant to capture the reciprocal relations within communities and between households based on trust deriving from social ties (Moser, 1998) particularly because these may be affected by the presence or the lack of energy. Political association is a further variable incorporated by RESURL and it exists by virtue of people's affiliation, favouratism or political interests. The social resource indicator is calculated in the following manner:

SR = N + Ms + LO + MP

Where **N** is networks,
Ms is mutual support,
G is groups,
CR is collective representation and
MR is mechanisms for participation.

Are the following indicators appropriate (please select the indicator if you agree) and, if you think there are additional indicators that need to be used, please name and describe them in the comment box. Please also justify your answer(s).

Networks
 Mutual Support
 Groups
 Collective Representation
 Mechanisms for Participation
 None of the above
 I don't know

Additional Indicators/Justification

Rural RE Delphi: Round 2

6. Human Resources Indicator

Human Resources refer to the qualities that can be improved, or otherwise, by the provision of energy.

$$HR = H + N + AW + Ed + Ks + D + FT + PP$$

Where H is health,
 N is nutrition,
 AW is access to clean water,
 Ed is education level,
 Ks is knowledge and skills,
 D is demographic factors,
 FT is free time and
 PP population participation.

Are the following indicators appropriate (please select the indicator if you agree) and, if you think there are additional indicators that need to be used, please name and describe them in the comment box. Please also justify your answer(s).

- ACCESS TO CLEAN WATER
- Health
- Nutrition
- Education Level
- Knowledge and Skills
- Demographic Factors
- Free Time
- Population Participation
- None of the above
- I don't know

Additional Indicators/Justification

7. ENERGY & TECHNOLOGY ANALYSIS

To establish the baseline status of current energy and technology in the community, there are a number of methods that can be used. The methods are described shortly below:

ASSESSMENT OF DEMAND PATTERNS

The demand assessment should identify the times at which energy is required and the quantity required by the user as well as the trend of future energy demand... the exercise should be inclusive so as to evaluate energy needs of poor and marginalized groups. The use of an energy service survey may very well provide the information needed.

Rural RE Delphi: Round 2**END-USE ANALYSIS**

Once the priority end-uses are identified...it is necessary to know how much energy is needed to produce particular goods and services at various stages of the energy chain, from primary energy production down to the provision of useful energy.

LOAD FACTOR

Load factor is the ratio of actual energy used to the total energy that would be delivered if the system operated continuously. Knowledge of the load factor provides information about the extent to which a given energy technology is actually exploited to for profitable use and is a good indicator of the financial viability of the system.

ENERGY SUPPLY AND AVAILABILITY PATTERNS

The supply and availability pattern of a technology is determined by a number of loosely connected technical considerations:

- Quantity of energy available
- Energy storage capacity
- Hours per day and days per year of operation

Please indicate which methods (if any) you regard as appropriate by selecting them. If there are additional methods you would propose, please name and describe them. Please also justify your answer(s).

- Demand patterns
- End-use Analysis
- Load Factor
- Quantity of Energy available
- Storage Capacity for Energy
- Hours per day and Days per year of operation
- None of the above
- I don't know

Additional Methods/Justification

**8. SKILLS ANALYSIS**

Do you think that a skills analysis is necessary? Please qualify your answer.

1. Definitely Yes
2. Possibly Yes
3. Possibly No
4. Definitely No
- I don't know

Comment



Rural RE Delphi: Round 2

9. WHY IS A SKILLS ANALYSIS NECESSARY?

- INDICATOR OF INCOME
- LOCAL MAINTENANCE ABILITY
- MEASURE OF TECHNOLOGICAL IGNORANCE
- OTHER
- N/A

Other (please specify)

10. INFORMATION GATHERING

Below are brief explanatory descriptions of the methods proposed for gathering information for the baseline analysis:

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Gender analysis is a term used to describe both the information gathered on gender in a community as well as the methods used to gather it. In this context, the term is used to describe the information gathering method.

It is defined as "...the range of methods used to understand and document the relationships between men and women, their access to resources, their activities and constraints they face as a function of their sexual category... gender analysis can inform the way in which women and men engage in planning, implementation and monitoring of projects..."

Rural RE Delphi: Round 2

(Mulugetta et. al., 2005: 43 – 47)

Please select which of the following methods you would recommend for the gathering of the abovementioned information.

If there are additional methods that you think should be used to gather this information, please name and describe them in the comment box. Please also justify your answer(s).

- Household Survey
 Semi-structured Questionnaire
 Participatory Rural Appraisal
 Gender Analysis
 Other

Additional Methods/Justification

**5. ANALYSIS AND DECISION SUPPORT**

The questions in this chapter are used to test the output delivered by the SURE decision support system as well as to determine what additional analyses are necessary to deliver appropriate technology options.

The software of SURE processes the information using the **Compromise Programming Multi-criteria Method of Yu (1973) and Zeleny (1973)**. With the information gathered, the SURE-DSS makes use of the following mathematical functions to calculate the appropriate different options:

$(C_j, j = 1, \dots, 5)$

$C_j(A_i) = 1 / (1 + e^{-M_j X_j(A_i)})$, $(j = 1, \dots, 5; i = 1, \dots, n)$

Where $C_j(A_i)$ represents the evaluation of the i -th energy alternative ($A_i, i=1, \dots, n$) against the resource $j, j=1, 2, \dots, 5$, (1 indicates Natural, 2 Physical, 3 Social, 4 Human and 5

Financial); $X_j(A_i)$ represents the effects of the i -th energy alternative on the corresponding community's resource j ; and M_j is a scale parameter, associated to the number of factors that compose each resource j .

$M_j = (20 * (X_j - a) / (b - a)) - 10$

Where a is the lower limit of the X_j range of values; and b is the upper limit of the X_j range of values.

The result of this analysis is a graphical depiction of the different options in the form of a pentagon, based on the 5 capitals used in the Sustainable Livelihoods approach. This pentagon's outer limits depict the ideal state of the community. The pentagon also shows the baseline of the community (before) as well as the effect that the different energy technologies are projected to have (after).

Rural RE Delphi: Round 2

As the developers of SURE put it:

The system allows the decision-maker to assess the effect that new operating energy systems might have on every asset owned by the community. It does so by calculating and comparing the different initial condition of the assets in a community with values resulting from the implementation of the new energy alternative in relation to an ideal condition of full development of all the resources. A main contribution of the system therefore is that it enables quantification, through a numerical index, of the gaps between the theoretical and ideal livelihood; the possible effects on livelihoods of particular energy technologies;

the existing condition of the assets and their possible improvement with the application of energy; and finally, the system calculates the trade-offs among alternative livelihoods with different energy solutions. The underlying goal of minimising the gap between the maximum possible value $\delta \frac{1}{4} 1P$ for each asset (a theoretical state) of greatest development and the real value that it could achieve through the application of an energy technology is illustrated

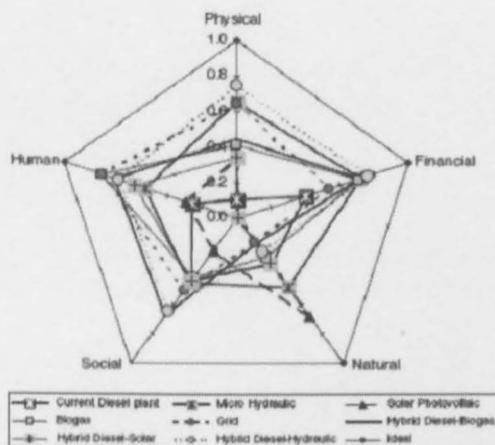


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Scores for most appropriate technology options, SJCN II, 2003

Solution number	Energy technologies	Score of appropriateness*
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3	Grid	0.8
4	Biogas	0.7
5	Hybrid diesel-biogas	0.6
6	Hybrid diesel-solar	0.4
7	Diesel plant	0.1
8	Solar photovoltaic	0.6

*The larger the score, the most appropriate the technology.

Rural RE Delphi: Round 2

1. Do you find the output of the SURE decision support system helpful, i.e. would you like to use it yourself? Please qualify your answer.

1. Definitely Yes
 2. Possibly Yes
 3. Possibly No
 4. Definitely No
 I don't know

Why?



2. Below is a list and descriptions of financial appraisal methods propagated by the ITDG manual:

SIMPLE PAYBACK

The simple payback time is the period, usually expressed in years, within which the initial investment is completely recovered.

$$P = C / (b - c)$$

Where P is the simple payback time, C the total capital cost of the project, b the projected annual benefits and c the projected annual running costs.

DISCOUNTED CASH FLOW ANALYSIS (a.k.a. Net Present Value)

... (discounted cash flow analysis) relies heavily on the principle of discounting future costs and benefits so as to represent them in terms of their present value.

INTERNAL RATE OF RETURN

The internal rate of return (IRR) on project X is defined as the discount rate r at which NPV (X,r) = 0.

THE GENERATION COST (This is the method used by SURE)

The generation cost methodology is a further variation of discounted cash flow analysis...the generation cost method provides a rather straightforward way of comparing the financial costs of different electricity generating options.

Please select which method(s), if any, you would use in addition to the generation cost method used by SURE, to evaluate the output delivered by SURE. If there are additional methods you would propose, please name and describe them. Please justify your answer.

- Simple Payback
 Discounted Cash Flow

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Internal Rate of Return
 None
 I don't know
Other (please specify)/Justification

3. ENVIRONMENTAL ANALYSIS

Below is a descriptive list of environmental impact analysis methods proposed by the ITDG:

ENVIRONMENTAL IMPACT ASSESSMENT (USED BY SURE)

In rural energy projects, the role of EIA is to provide information to stakeholders and other concerned parties about the impact of the project on the environment, both human and natural.

ENERGY ANALYSIS

Energy Analysis is used to calculate all the energy inputs per unit of output of a product, process or system. It is important for the determining the viability of energy systems from a resource perspective and can also be used to calculate the energy payback time.

LIFE-CYCLE ANALYSIS

Life-cycle analysis goes farther than energy analysis in that it looks at all the impacts (not just energy) of all the components of a product over its lifetime.

Please select the method(s) that you would propose. If there are additional methods, please name and describe them. Also please justify your answer.

Environmental Impact Assessment (EIA)
 Energy Analysis
 Life-Cycle Analysis
 None
 I don't know
Other (please specify)/Justification

6. IMPLEMENTATION STRATEGY

This page will assess the appropriateness of the implementation strategy proposed by the ITDG manual.

1. The ITDG manual proposes a Community Action Plan (CAP) to effect implementation.

A CAP is a process which enables communities to design, implement and manage their own programme or project. The action plan is developed in an intensive workshop, which is participatory, community-based and problem-driven. The development plan is outlined through a process of problem prioritization and formulation of strategies and options for dealing with the problems. Central to the method is the setting up of partnerships between local people and the project staff in a mutual learning process of dialogue, negotiation and decision-making. The CAP can be complemented by diagnostic tools such as Stakeholder Analysis or PRA to identify the main actors and the principal problems.

The stages of a CAP process are:

- § 1. Problem identification and prioritizing
- § 2. Consider alternative courses of action
- § 3. Identify the tasks and the retrospective actors involved
- § 4. Identify gaps and weak linkages
- § 5. Agreement on coordination mechanisms
- § 6. Agreement on indicators and monitoring mechanisms

(Mulugetta et. al., 2005: 47 – 49)

Would you make use of this method? If not, please name and describe what methods you would propose. Also please justify your answer.

- 1. Definitely Yes
- 2. Possibly Yes
- 3. Possibly No
- 4. Definitely No
- I don't know

Other (please specify)/Justification



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7. MONITORING & EVALUATION

This page aims to evaluate the appropriateness of the Monitoring and Evaluation methods proposed by the ITDG Manual.

1. The ITDG manual proposes the use of Participatory Monitoring and Evaluation (PM&E):

PM&E is a process of self-assessment, knowledge generation, and collective action in which stakeholders in a programme or intervention collaboratively define the evaluation issues, collect and analyse data and take corrective action as a result of what they learn through this process.

The stakeholders usually involved in PM&E activity include the end-users of project goods and services, intermediary organizations such as NGOs, private sector business and government staff at various levels.

The fundamental processes of PM&E are as follows:

- § Establish framework
- § Identify indicators to be used
- § Gather the data
- § Analyze
- § Agree on findings and what to do next

Would you also propose the use of PM&E? Please name and describe any other methods that you would propose. Please also justify your answer.

- 1. Definitely Yes
- 2. Possibly Yes
- 3. Possibly No
- 4. Definitely No
- I don't know

Other (please specify)/Justification

Appendix C: General Response Document - Round 1

Section	Question	Responses	Comments/Justification
Policy Environment Analysis	<i>Do you think that this is necessary?</i>	Definitely Yes 57,1 %	Have to design to a need of the stakeholders. Have to maintain the installation.
		Possibly Yes 28, 6%	To determine the need and affordability
		Possibly No 0, 0%	It is a necessary step because policy facilitates prudent action and implementation and the environment needs to be conducive for such action for policy to be an enabling factor.
		Definitely No 14, 3%	The industry is able to make its own decisions regarding the correct products for and the route to market. The end users are able to make their own decisions in terms of what they can afford.
		I do not know 0, 0%	Given the huge range of (developmental) policy in SA, one can get bogged down in working through the interconnections between it all - and this may hold up progress on the ground. But it is definitely important to understand the policy context.
			Generally development work occurs in a specific policy environment which dictates what will be done. This has been particularly true given that many initiatives have been top-down
	<i>Which methods would you use for the analysis?</i>	Document Analysis 50, 0%	To illustrate what I understand when I marked the first one. In the Limpopo there is the Limpopo Province Energy Forum that meets on a regular basis. Represented are the relevant ministries and other stake holders dealing with energy and energy related issues. At the DME there are also certain key personnel dealing with certain aspects/divisions in particular for the country.
	Questionnaire 50, 0%		
	Interviews and Workshops 66, 7%		
	Activity/Responsibility Matrix 0%		
	Stakeholder analysis 33, 3%	Focus group Discussions (though this may have been assumed under workshops). NB I may not be familiar with all the methods and would not be able to judge in some cases.	

		Micro-mapping	0, 0%	
		Problem-tree	33, 3%	
		SWOT	50, 0%	
		STEP	50, 0%	
		7-S model	16, 7%	
		None of the Above	0, 0%	
Community Stakeholder Analysis	<i>Would you carry out a Community Stakeholder Analysis?</i>	Definitely Yes	85, 7%	To be able to install a compatible system designed on the need of the stakeholder.
		Possibly Yes	0%	Such a project cannot be conducted in isolation and need to access the influence of other role players and to determine the need.
		Possibly No	0%	
		Definitely No	14, 3%	Any undertaking (project) has intended beneficiaries and role players. The community as a stakeholder forms an integral part to ensure participation and success. It is very difficult to impose on a community, no matter how noble the intentions of the project are. The community needs to feel ownership and have a good understanding of project goals and how these meet their immediate needs. Rural communities tend not to have long term plans, it is very much here and now, so the project has to have community appeal.
		I do not know	0%	Individuals in communities have the right to determine what they will or won't purchase.
				Does not work without it!
				There are often complex relationships in communities and failing to appreciate them can compromise an otherwise sound

			project e.g. where certain powerful interests feel sidelined or threatened by the project
	<i>Which methods would you use for the analysis?</i>	<p>Wealth Ranking 33, 0%</p> <p>Venn Diagrams 66, 7%</p> <p>Questionnaires & Surveys 50, 0%</p> <p>Secondary Data Analysis 50, 0%</p> <p>Observation 66, 7%</p> <p>Focus Group 33, 0%</p> <p>In-depth Interviews 50, 0%</p> <p>None of the above 0 %</p>	I am not familiar with what the above mentioned methods exactly entail but you need to conduct surveys to determine income, demand, affordability from sample households and then you need to get information from leaders/leadership groups whether political or traditional and institutional organizations.
Baseline Analysis	<i>Do you think that this is necessary?</i>	<p>Definitely Yes 57, 1%</p> <p>Possibly Yes 42, 9%</p> <p>Possibly No 0, 0%</p> <p>Definitely No 0, 0%</p> <p>I do not know 0, 0%</p>	<p>One must have an understanding of the stakeholder and their needs</p> <p>It is an impact assessment prior to project implementation.</p> <p>It will prove the long term success or failure of the project.</p> <p>This is a very useful tool for measuring impact. It is also critical information for developing the business case for the project. If impact is not going to be assessed, and the business case does not need proving, then I would question the value of doing the baseline analysis.</p> <p>If impact is to be assessed later it may be necessary, but it may be impractical to carry out baseline analyses for every project.</p>

<p>Community Resources/Capitals</p>	<p><i>Physical Resource Indicator: Which Indicators do you find appropriate?</i></p>	<p>Available Infrastructure 85, 7%</p> <p>Means of Communication 71, 4%</p> <p>Tools, technology and services of the technology system 85, 7%</p>	<p>Without these you cannot start a project</p> <p>Any form of RE is still relatively new in rural applications so to be able to roll out effectively especially on a larger scale you need to familiarize yourself on these factors in order to roll out efficiently.</p> <p>Implementation requires infrastructure as a means to an end, the project needs to be communicated at various stages to various already identified stakeholders. Project implementation relates to provision of a service and technology is required primarily as an interface and data hub and tools relate to project execution (on and off site).</p> <p>Income per capita before project</p>
	<p><i>Financial Resources Indicator: Which indicators do you find appropriate?</i></p>	<p>Financial Institutions 71, 4%</p> <p>Wages and Stock 100, 0%</p> <p>None of the Above 0%</p> <p>I do not know 0%</p>	<p>Indicators seem reasonable</p> <p>Affordability is a key factor because rural people are mostly poor and institutions reluctant to finance projects in this regard. Therefore you will mostly have to rely on governmental subsidized initiatives. Is it going to be a once off capital investment or is there also an ongoing maintenance fee at stake. They are subsistence farmers and generally do not produce in excess. Wages are government subsidized pension funds or other similar initiatives for example the indigent policy covering subsidized services.</p> <p>In rural communities, sources of income rarely are multiple so, key sources need to be identified. Security required by financial institutions is a rarity thus they are not an absolute requirement. Rural communities tend not to have the disposable income to facilitate the accumulation of wealth. key considerations of the community are mostly day to day</p> <p>Presumably wages and income from sale of stock would be used to repay finance institution if end user elects to purchase a system and does not have the cash to do so.</p> <p>Access to Microfinance; knowledge/experience with co-operatives</p>

	<p><i>Natural Resources Indicator:</i> <i>Which indicator do you find appropriate?</i></p>	<p>Solar Insolation 71, 4%</p> <p>Water availability 71, 4%</p> <p>Biomass Waste 42, 9%</p> <p>Biodiversity 42, 9%</p> <p>Landscape Value 57, 1%</p> <p>Land available for Energy Production 57, 1%</p> <p>None of the above 14, 3%</p> <p>I do not know 14, 3%</p>	<p>People are inclined to live where there is sunshine and not too much wind. Wind energy thus will require generation and transmission except if it is occasional and moderate which add to design challenges and the issue of efficiency. Water is a necessity and can become even more of a challenge if it is required in vast quantities for industrial purposes.</p> <p>If the area where people were living were not liveable, they would not be living there. Presumably the denser the population, the more favourable the above conditions would be. The project is about the end user, where there is an end user, there is a market.</p> <p>It clearly depends on the nature of the energy system being planned. In my case, for biogas, I would not be that interested in solar insolation, but all the rest would be of interest.</p>
	<p><i>Social Resources Indicator:</i> <i>Which indicators do you find appropriate?</i></p>	<p>Networks 71, 4%</p> <p>Mutual Support 71, 4%</p> <p>Groups 57, 1%</p> <p>Collective Representation 42, 9%</p> <p>Mechanisms for Participation 57, 1%</p> <p>None of the above 14, 3%</p> <p>I do not know 14, 3%</p>	<p>Out of my experience/knowledge.</p> <p>Not sure of the detailed difference between indicators 4 and 5.</p> <p>Rural people are socialistic and are usually grouped in geographic areas under a traditional, social or political leader with a representative body from and on behalf of the community.</p> <p>Social resources relate to collective execution and following in others footsteps. In certain instances there isn't any access to information thus collective bargaining or consensus are key and these indicators are part and parcel thereof.</p> <p>This is discriminatory. As long as an individual can afford a service they should not be denied access to it.</p>

	<i>Human Resources Indicator: Which indicators do you find appropriate?</i>	<p>Health 71, 4%</p> <p>Nutrition 100, 0%</p> <p>Education level 100, 0%</p> <p>Knowledge & skills 100, 0%</p> <p>Demographic factors 57, 1%</p> <p>Free time 71, 4%</p> <p>None of the above 0, 0%</p> <p>I do not know 0, 0%</p>	<p>Access to clean water missing from options</p> <p>All these factors or indicators are influenced by access to information with energy provisioning is facilitated.</p> <p>How would an improvement or otherwise of D or PP be defined or measured?</p>	
Energy and Technology Analysis	<i>Which methods do you find appropriate for evaluating energy and technology?</i>	<p>Demand patterns 85, 7%</p> <p>End-use analysis 71, 4%</p> <p>Load factor 57, 1%</p> <p>Quantity of Energy Available 85, 7%</p> <p>Storage capacity for energy 71, 4%</p> <p>Hours per day and days per year of operation 71, 4%</p> <p>None of the above 14, 3%</p>	<p>The above methods facilitate need analysis and benefit accruing based on needs and ultimate use.</p> <p>The primary indicator of project viability should be what the end user can afford. Very rarely if ever can the expectations of a wish list be met, especially so with stand-alone photovoltaic systems.</p>	

		I do not know	0, 0%	
Skills Analysis	<i>Do you think that a skills analysis is necessary?</i>	Definitely Yes	28, 6%	If one is interested in developing social capital and maximizing local job creation.
		Possibly Yes	71, 4%	Certainly important to know what skills are on hand in village for tapping into for training others and for involvement in project work.
		Possibly No	0, 0%	To find the stakeholder who can maintain the system.
		Definitely No	0, 0%	Levels of literacy and skills are of significance in the sense that ignorance can kill a project and then you need to get the buy-in from the people in order to make a project work.
		I do not know	0, 0%	This relates to ensuring that there are grounds to implement a project using community available resource, it also relates to ensuring ownership.
				If an end user can afford a product, presumably they have sufficient skills to generate the required income to afford it. Whether or not the project results in an improvement in skill levels would be interesting.
Information Gathering	<i>Which of the following methods would you recommend for gathering the abovementioned information?</i>	Household Survey	85, 7%	These indicators relate to ensuring understanding that will impact project implementation and success.
		Semi-structured Questionnaire	42, 9%	Household survey would be most accurate as information would be gathered directly from end users who would be the target market.
		Participatory Rural Appraisal	14, 3%	
		Gender Analysis	28, 6%	
		Other	0, 0%	

SURE	<i>Do you find the output of the Sure Decision Support System helpful, i.e. would you like to use it yourself?</i>	<p>Definitely Yes 57, 1%</p> <p>Possibly Yes 42, 9%</p> <p>Possibly No 0, 0%</p> <p>Definitely No 0, 0%</p> <p>I do not know 0, 0%</p>	<p>The depiction of the output makes comparisons relatively easy.</p> <p>Not sure if we need it???</p> <p>If I were in a position to impose a technology on a community, it would make me better prepared to do this. Otherwise it would be of little use as the community would only purchase what they can afford on individual levels and not as a community.</p> <p>Yes because it does not only quantify the need but also the preference</p> <p>Integrated use of energy has always been a factor for consideration and integrated use of energy will be imperative in rural rather than urban areas. Appropriateness and the process leading to such assertions are critical.</p> <p>Nice to know when you're on the right track ...</p>
	<i>Which financial appraisal methods would you use to evaluate the output of the SURE decision support system?</i>	<p>Simple Payback 57, 1%</p> <p>Discounted Cash Flow 42, 9%</p> <p>Internal Rate of Return 42, 9%</p> <p>None 14, 3%</p> <p>I do not know 0, 0%</p>	<p>Generation cost missing from options (<i>The question asks: which methods, IN ADDITION TO THE GENERATION COST METHOD USED BY SURE, would you recommend?</i>)</p> <p>This seems to be implying a fee for service model in which prepayment is used to recover capital costs? Prepayment models burden the already poor community with an unnecessary overhead cost, and make the assumption that the poor are there as a ready annuity income for the concessionaire. While this may work in reticulated networks where the annuity income from the affluent can subsidize the cost of getting energy to the poor, in this case the poor have no such subsidy unless they are receiving systems as part of a project - and such projects are notorious for causing harm to the already established (or recovering from the last project) industry. In the ownership model, the payback is instant, the supplier is paid COD for a system which the end user could afford, by whatever means.</p> <p>Keep it simple.</p>

	<i>Which methods would you use to conduct an environmental analysis of SURE's output?</i>	<p>Environmental Impact Assessment 71, 4%</p> <p>Energy Analysis 85, 7%</p> <p>Life-Cycle Analysis 71, 4%</p> <p>None 14, 3%</p> <p>I do not know 0, 0%</p>	<p>Considering that the environmental impact of the lifestyles of the affluent has an almost immeasurably greater impact than the lifestyles of the poor, what's the point when considering the environmental impact of a solar home system by comparison? Granted, it takes energy to produce a solar home system, but how much more energy does it take to produce a TV set, fridge, automobile, or any of the other niceties that are part of the disposable world of the affluent? Other than the energy required to produce the SHS, other considerations would be recycling of lead battery or disposal of CFL when at the end of their life, but these are in minute volumes compared with automotive batteries or CFLs used and disposed of in the lives of the affluent. What would be the reaction of the affluent to an in-depth analysis of their lives on the scale that the poor are subjected to?</p> <p>These are all encompassing issues related to, the environment has most impact on rural communities, and their livelihood is derived from such. Viability assessment is key and the life cycle needs to be assessed from a reinvestment point of view to facilitate planning for replacement, refurbishment, etc.</p>
Community Action Plan	<i>Would you make use of this method to implement the project?</i>	<p>Definitely Yes 42, 9%</p> <p>Possibly Yes 42, 9%</p> <p>Possibly No 0, 0%</p> <p>Definitely No 14, 3%</p> <p>I do not know 0, 0%</p>	<p>Most of the stages are already used even if known by different names.</p> <p>Projects such as these, although almost always have the best intentions of communities at heart, do more harm than good. The team which set the project in place, the driving force behind the project, cannot possibly be kept together for the duration of the life of the technology rolled out in the community. A project has a defined beginning and end. When it ends, the driving force pulls out, the money is taken away, interest dwindles - systems fail and are not maintained. The project is only a "success" while the project team is intact. Small enough SHS exist that can be afforded by individuals in communities, and those who want the technology invariably seek it out, educate themselves, and are not afraid to fiddle to learn because the system is theirs. Where a market for small SHS exists, it is in the interests of the seller to provide reasonable after sales service to ensure future sales. Projects rolling SHS into poor rural communities could probably be likened to authorities</p>

				<p>telling a suburban affluent community that in future they will all drive exactly the same car - when so many other options exist that cater to the personal needs and preferences and affordability levels of the drivers. Let the industry develop the market. Rural SHS projects destroy the best efforts of the industry - why would anyone want to buy a SHS from a systems integrator in the PV industry when sooner or later some benevolent do-gooder will come along and provide one for free or by other mechanism that excludes the local industry...and then leave?</p> <p>There is a need to optimizing operations, more so in rural areas as resources (generically) are limited.</p> <p>Unfortunately accessing funding to do this level of interaction with the beneficiaries is just not generally available. Hence by definition these projects often begin without this critical task having been undertaken.</p>
Participatory Monitoring & Evaluation	<i>Would you make use of this method to monitor and evaluate the project?</i>	<p>Definitely Yes 57, 1%</p> <p>Possibly Yes 28, 6%</p> <p>Possibly No 0, 0%</p> <p>Definitely No 14, 3%</p> <p>I do not know 0, 0%</p>	<p>Evaluation activities often get overlooked so that many lessons are not learnt</p> <p>The industry will take care of it. Identify the need and affordability level, develop the solution, and sell the solution. If anything does not work, the seller has the direct complaints of many direct end users to contend with, whom he must satisfy or go out of business. The other picture is the stifled mutters of a community respectful of their leaders or chiefs in cahoots with project teams who have predetermined the outcomes, and then walk away to write papers on their failings.</p> <p>Consensus on way forward is key to project longevity.</p>	

Appendix D: General Response Document – Round 2

Section	Question	Responses	Comments/Justification
Policy Environment Analysis	Do you think that this is necessary?	Definitely Yes 83, 3 %	To accentuate enabling factors whilst mitigating or eliminating constraining factors within a policy framework.
		Possibly Yes 16, 7%	It imperative that you know and acknowledge the parameters in which you are going to operate
		Possibly No 0, 0%	Insofar as product made available to end users meets a certain minimum performance standard I agree that policies are useful. Where these policies interfere with the course of usual free trade in PV products to end users, I would say that such policy is unnecessary.
		Definitely No 0, 0%	
		I don't know 0, 0%	Needs of a community can be fulfilled
	Which methods would you use for the analysis?	FOCUS GROUPS 66, 7%	Standards authority like SABS would add value in determining quality of products on offer to the market.
		Document Analysis 33, 3%	
		Questionnaire 66,7%	
		Interviews and Workshops 66, 7%	
		Activity/Responsibility Matrix 16, 7%	
		Stakeholder analysis 33, 3%	
		Micro-mapping 16, 7%	

		Problem-tree	33, 3%	
		SWOT	16, 7%	
		STEP	16, 7%	
		7-S model	16, 7%	
		None of the Above	16, 7%	
Community Stakeholder Analysis	<i>Would you carry out a Community Stakeholder Analysis?</i>	Definitely Yes	83, 3%	To get buy-in
		Possibly Yes	0%	There are often complex relationships and powerful elements that can derail a project unless they are understood and properly involved.
		Possibly No	0%	Role players will determine the success or failure of a project and therefore need to be acknowledged
		Definitely No	16, 7%	It infringes on the rights and freedoms of individuals in the community to make their own free choices where other sources of PV solutions are available.
		I don't know	0%	Needs can be assessed.
	<i>Which methods would you use for the analysis?</i>	Wealth Ranking	40, 0%	I am not familiar with what the above mentioned methods exactly entail but you need to conduct surveys to determine income, demand, affordability from sample households and then you need to get information from leaders/leadership groups whether political or traditional and institutional organizations.
		Venn Diagrams	60, 0%	
		Questionnaires & Surveys	80, 0%	
		Secondary Data Analysis	40, 0%	
		Observation	60, 0%	

		Focus Group	60, 0%	
		<i>In-depth Interviews</i>	<i>40, 0%</i>	
		None of the above	0 %	
Per Capita Income	<i>Do you think that it is necessary to determine the average per capita income of the community as part of the preparatory analysis?</i>	Definitely Yes	66, 7%	Average per capita income is difficult to accurately determine in rural communities. Sources of income are too varied and can sometimes not be pre-determined.
		Possibly Yes	16, 7%	That will give you an idea of what income you can expect in terms of payments and purchases.
		Possibly No	16, 7%	It would enable a prospective dealer to package a solution which is affordable in order that they may pitch at the right level.
		Definitely No	0, 0%	Need to know what can be afforded
		I don't know	0, 0%	
Baseline Analysis	<i>Do you think that this is necessary?</i>	Definitely Yes	66, 7%	To outline the bottom-line and set standards for sustainable project success.
		Possibly Yes	16, 7%	Would be useful for any subsequent impact analysis. May be impractical to do baselines for every project.
		Possibly No	0, 0%	Any project of significance usually does have an impact on these conditions and therefore should be analyzed.
		Definitely No	16, 7%	From our perspective, although there could possibly be some marketing value should the outcome of such an analysis where the deployment of an SHS had a profound effect on the lives of individuals (such as someone obtaining distinctions at studies or someone converting the system into a business opportunity), the opportunities opened up to an individual should they have a SHS system would be part of the initial marketing campaign of the dealer active in the area anyway.
		I don't know	0, 0%	

			To design a system - all factors need to be assessed.
Community Resources/Capitals	<i>Physical Resource Indicator: Which Indicators do you find appropriate?</i>	<p>Available Infrastructure 83, 3%</p> <p>Means of Communication 66, 7%</p> <p>Tools, technology and services of the technology system 83, 3%</p> <p>None of the above 16, 7%</p>	<p>Infrastructure, tools, technology and the energy system are integral to project implementation. The project has to be communicated to stakeholders as it traverses through various stages.</p> <p>The more physical resources are available, the less you need to bring in or establish and it can contribute to the efficiency of the project.</p> <p>From our perspective, should the end user be able to afford the system or not would be the sole determining factor. By virtue of the fact that a community exists, it has by default an infrastructure, and means of communication, and in the poorest of the poor only usually a rudimentary light kit or cell phone charger or radio power source is affordable.</p>
	<i>Financial Resources Indicator: Which indicators do you find appropriate?</i>	<p>ACCESS TO MICRO-FINANCE 66, 7%</p> <p>KNOWLEDGE/EXPERIENCE WITH CO-OPERATIVES 50, 0%</p> <p>Financial Institutions 83, 3%</p> <p>Wages and Stock 100, 0%</p> <p>None of the Above 0, 0%</p> <p>I don't know 0, 0%</p>	<p>Rural communities do not have security required by micro-finance and financial institutions.</p> <p>Micro-finance, if properly facilitated, executed and managed can be a solution if there is a financial institution willing to commit - established ones are reluctant.</p> <p>Useful information for prospective dealer.</p>
	<i>Natural Resources Indicator: Which indicator do</i>	<p>POPULATION DENSITY 66, 7%</p> <p>Solar Insolation 83, 3%</p>	<p>Rural communities look at survival and thus resources are utilized extensively</p> <p>Whatever is available or any combination thereof will determine</p>

	<i>you find appropriate?</i>	<p>Water availability 83, 3%</p> <p>Biomass Waste 66, 7%</p> <p>Biodiversity 66, 7%</p> <p>Landscape Value 50, 0%</p> <p>Land available for Energy Production 83, 3%</p> <p>None of the above 16, 7%</p> <p>I don't know 0, 0%</p>	<p>the nature of the energy product.</p> <p>Our business is solar PV, particularly favoring individual solar home systems where the individual has the power to choose whichever solution he can afford. Water turbines, wind power, biomass digesters assume mini-grid solution, which only works initially with buy-in from the entire community, and ultimately fails without ongoing high level technical input readily available in the community.</p>
	<i>Social Resources Indicator: Which indicators do you find appropriate?</i>	<p>Networks 83, 3%</p> <p>Mutual Support 66, 7%</p> <p>Groups 66, 7%</p> <p>Collective Representation 66, 7%</p> <p>Mechanisms for Participation 66, 7%</p> <p>None of the above 16, 7%</p> <p>I don't know 0, 0%</p>	<p>Rural communities operate within the confines of collective and mutual co-existence.</p> <p>Rural people have close social ties because they have the same values and conditions while political affiliations is a powerful tool, which is used to unite people.</p> <p>This could be viewed as discriminatory. If someone is able to afford their own solution, I don't see how any of the above would prevent them from doing so.</p>
	<i>Human Resources</i>	ACCESS TO CLEAN WATER	Adequate clean water recommended because it influences

	<p><i>Indicator: Which indicators do you find appropriate?</i></p>	<p>Health 83, 3%</p> <p>Nutrition 66, 7%</p> <p>Nutrition 83, 3%</p> <p>Education level 83, 3%</p> <p>Knowledge & skills 100, 0%</p> <p>Demographic factors 33, 3%</p> <p>Free time 66, 7%</p> <p>None of the above 0, 0%</p> <p>I don't know 0, 0%</p>	<p>public health.</p> <p>Safety is also supposed to improve because they do not need to collect wood (snakes etc.), fires and reduction of criminal activities.</p> <p>The above are perhaps useful in determining an appropriate marketing strategy, and benefits of having small SHS.</p> <p>Education level could improve, along with knowledge and skills, and free time could be occupied by leisurely radio or TV listening.</p>
<p>Energy and Technology Analysis</p>	<p><i>Which methods do you find appropriate for evaluating energy and technology?</i></p>	<p>Demand patterns 83, 3%</p> <p>End-use analysis 66, 7%</p> <p>Load factor 66, 7%</p> <p>Quantity of Energy Available 83, 3%</p> <p>Storage capacity for energy 66, 7%</p> <p>Hours per day and days per year of operation 83, 3%</p>	<p>The above are key considerations of optimal energy provision.</p> <p>The type of technology to be used will affect these factors.</p> <p>The end user will buy whatever they can afford and live with what it gives them. Having a "wish list" is of little use if the solution is out of reach financially.</p>

		None of the above	16, 7%	
		I don't know	0, 0%	
Skills Analysis	<i>Do you think that a skills analysis is necessary?</i>	Definitely Yes	50, 0%	Skills analysis will inform means of project implementation and skills. To be enhanced through energy provision and/or access.
		Possibly Yes	33, 3%	Irrelevant if the end user has the means by which to purchase a system.
		Possibly No	0, 0%	
		Definitely No	16, 7%	
		I don't know	0, 0%	
	<i>WHY IS A SKILLS ANALYSIS NECESSARY?</i>	INDICATOR OF INCOME	16, 7%	Skill enhancement
		LOCAL MAINTENANCE ABILITY	83, 3%	
		MEASURE OF TECHNOLOGICAL IGNORANCE	33, 3%	
		OTHER	16, 7%	
		N/A	16, 7%	
Information Gathering	<i>Which of the following methods would you recommend for gathering the</i>	Household Survey	83, 3%	The above selected methods are designed to pinpoint stakeholder interaction to best benefit a project.
		Semi-structured Questionnaire	66, 7%	Product presentation and demonstration.
		Participatory Rural Appraisal	66, 7%	

	<i>abovementioned information?</i>	Gender Analysis	16, 7%	
		Other	16, 7%	
SURE	<i>Do you find the output of the Sure Decision Support System helpful, i.e. would you like to use it yourself?</i>	Definitely Yes	66, 7%	It can consolidate the intertwined sources of energy to produce an optimal energy system based on community specific indicators.
		Possibly Yes	16, 7%	Format of output facilitates comparison.
		Possibly No	0, 0%	A good tool to measure your success.
		Definitely No	16, 7%	As solar PV is our business, solar PV will be the only logical first choice for us. Other energy solutions are required to be usually single centralized generating systems shared between the community, and if it fails the entire community is left in the dark, possibly until the generator is eventually shipped off as scrap metal.
		I don't know	0, 0%	It may be helpful.
	<i>Which financial appraisal methods would you use to evaluate the output of the SURE decision support system?</i>	Simple Payback	66, 7%	Simple financial indicators defines bottom-line financially.
		Discounted Cash Flow	66, 7%	You can use either one or a combination depending on given circumstances.
		Internal Rate of Return	66, 7%	
		None	0, 0%	
		I don't know	16, 7%	
	<i>Which methods would you use to</i>	Environmental Impact Assessment	83, 3%	Lifespan prudent use of energy resources and the impact on the environment (human and natural) are key considerations to

	<i>conduct an environmental analysis of SURE's output?</i>	<p>Energy Analysis 83, 3%</p> <p>Life-Cycle Analysis 83, 3%</p> <p>None 16, 7%</p> <p>I don't know 0, 0%</p>	<p>successful implementation and use of energy.</p> <p>You need to conduct at least an EIA and at least one of the other two</p> <p>Whatever impact the rural poor have on their environment is infinitesimal compared with the impact the rich have on theirs, in terms of carbon footprint and considering the population densities in rural areas where human impact is less anyway. Where components of proposed systems do pose a known environmental risk such as the recovery of scrap lead or the disposal of worn out CFL, due to the low density of scrap batteries it will not be financially viable to travel to the area to recover the lead anyway or dispose of CFL in environmentally friendly way - so it won't be done unless there is a financial benefit for someone to do it.</p>
Community Action Plan	<i>Would you make use of this method to implement the project?</i>	<p>Definitely Yes 83, 3%</p> <p>Possibly Yes 0, 0%</p> <p>Possibly No 0, 0%</p> <p>Definitely No 16, 7%</p> <p>I don't know 0, 0%</p>	<p>All implementation means must look at quick solutions, remedying actions as well as preventative actions (retro- and pro-actively)</p> <p>If you want to work in a community you need to do it in conjunction with that community</p> <p>In my opinion such processes are devised to have a community accept a solution an outsider intends to impose on them, and they probably have limited options.</p>
Participatory Monitoring & Evaluation	<i>Would you make use of this method to monitor and evaluate the project?</i>	<p>Definitely Yes 50, 0%</p> <p>Possibly Yes 50, 0%</p> <p>Possibly No 0, 0%</p> <p>Definitely No 0, 0%</p>	<p>The fundamental processes of PM&E ensure structure, cohesion and prudent action</p> <p>In an ever changing environment which is something given you need to assess and evaluate success and achievement.</p> <p>From a marketing perspective such an evaluation could be useful in determining strategy for future target markets.</p>