UNITED NATIONS DEVELOPMENT PROGRAMME
GLOBAL ENVIRONMENT FACILITY

Medium-Size Project Brief – South Africa

PROJECT IDENTIFIERS	
1. Project name: *Pilot production and commercial dissemination of solar cookers in South Africa*	2. GEF Implementing Agency: *UNDP*
3. Country or countries in which the project is being implemented: *South Africa*	4. Country eligibility: *South Africa ratified the UNFCCC in August 1997*
5. GEF focal area(s): *Climate Change*	6. Operational programme: *OP6: Promoting the Adoption of Renewable Energy by Removing Barriers and Reducing Costs*
7. Project linkage to national priorities, action plans, and programmes: *According to the White Paper on Energy Policy of the Republic of South Africa, which was approved by Cabinet on 2 December 1998: "The energy sector has larger environmental impacts than most other economic sectors, with associated greenhouse gas emissions feared to be a major contributor to global warming. Energy policies are already responding to pressures to reduce emissions as energy investments are subjected to greater environmental scrutiny. [...] The research and development of alternative and renewable energy sources is also being promoted. As a signatory to the UNFCCC, South Africa intends to play a constructive role in the alleviation of environmental emissions". Part of South African Energy Policy is conducting pilot projects in order to promote the use of renewable energy resources and appliances. In this context the Department of Minerals and Energy (DME) and the German Technical Cooperation (GTZ) undertook a phase I pilot project to investigate the social acceptability and functional appropriateness of 7 solar cookers selected for a comparative test on the basis of cooking profiles for 3 areas. The (successful) results have led to the development of a second phase consisting of the pilot production and commercial dissemination of 3-4 different solar cooker model for which assistance is being requested from UNDP/GEF.*	
8. GEF national operational focal point and date of country endorsement: *Department of Environmental Affairs and Tourism (DEAT), Dr. Crispian Olver, date: 27 April 2001*	
PROJECT OBJECTIVES AND ACTIVITIES	
9. Project rationale and objectives: *The objective of the proposed project is to remove barriers to the (increased) commercial production, retailing, servicing and use of solar cookers, thereby substituting the use of unsustainable wood fuels and fossil fuels and reducing GHG emissions as a result of that.*	Indicators: - *Number of solar cookers produced, sold, serviced and used.* - *Reduced GHG emissions.*

10. Project outcomes:	Indicators:
- *3-4 Solar cooker models designed and mass produced in SA.*	- *Solar cooker models and mass production facilities/infrastructure.*
- *2,000 Solar cookers produced and distributed the first 2 years of project implementation*	- *Solar cookers in use in target areas*
- *.Distribution, retail and service channels capable of mass dissemination of solar cookers adequately developed.*	- *Solar cookers available at rural outlets in combination with after sales service*
- *Increased awareness among key stakeholders (rural women) about the potential, availability and affordability of solar cookers.*	- *Basic knowledge and awareness levels with target group*
- *Increased human and institutional capacity for continued development of the solar cooker sector.*	- *More people involved in solar cooker development*
- *A policy context, including policy instruments conducive for accelerated solar cooker development and dissemination developed.*	- *Solar cookers favourably addressed in SA RE policy*
- *50,000 Solar cookers disseminated in a 6 year period.*	- *Number of cookers sold and used.*
- *Direct fossil fuel savings as a result of the dissemination and use of 50,000 solar cookers, with a lifetime of 5 years ranges from 135,000 to 225,000 tonnes of CO_2.*	- *Measurable GHG emission reduction and reduction in fossil fuel use.*
11. Project activities to achieve outcomes (in US$):	Indicators:
- *Mass manufacturing infrastructure (US$ 370,000)*	- *Mass production activities*
- *Distribution infrastructure (US$ 400,000)*	- *Solar cooker stoves sold in rural areas in large numbers*
- *Awareness and promotion (US$ 335,000)*	- *Number of people interested in solar cookers and buying them*
- *Price reduction and affordability (US$ 90,000)*	- *Solar cookers affordable for a large percentage of the target group*
	- *Report on pilot implementation*
- *Monitoring pilot activities (US$ 25,000)*	- *Dissemination strategy*
- *Design of dissemination strategy (US$ 60,000)*	- *50,000 solar cookers sold in 6 years*
- *Implementation dissemination strategy (US$ 1,510,000)*	- *Increased awareness in and outside the target areas*
- *Information exchange/workshops (US$ 45,000)*	- *Exit strategy implemented*
- *Exit strategy design & implementation (US$ 50,000)*	- *GHG emission reductions measurable and accountable to the project*
- *GEF monitoring and evaluation (US$ 15,000)*	

12. Estimated budget (in US$):

PDF A:	*0*
GEF:	*800,000*
Solar cooker buyers:	*2,250,000*
Co-financing:	*500,000 (Germany)*
Co-financing:	*100,000 (DME)*
Grand total:	***3,650,000***

Note: *During phase I and phase II that already commenced in 1999, an amount of US$ 3.2 million has been invested in the solar cooker programme by the Government of Germany (US$ 3 million) and the Government of South Africa (US$ 200,000).*

INFORMATION ON INSTITUTION SUBMITTING PROJECT BRIEF

13. Information on the project proposer/executing agency: *The proposer is the Department of Minerals and Energy (DME), Pretoria, South Africa who have jointly with the Federal Republic of Germany lead and implemented phase I of the solar cooker programme over the period 1999-2000. Within the DME, Mr. Tony Golding will be the officer in charge for the design, preparation and implementation of the proposed MSP. Mr. Golding's coordinates are: tel: +27 12 317 9213, fax: +27 12 322 5224, e-mail: tony@mepta.pwv.gov.za*
14. Information on proposed executing agency (if different from above): *n.a.*
15. Date of initial submission of project concept: *no concept paper was submitted*
INFORMATION TO BE COMPLETED BY IMPLEMENTING AGENCY:
16. Project identification number:
17. Implementing Agency contact person: *UNDP South Africa, Mr. Thulani Mabaso, environmental programme officer, tel: +27 12 338 5031, fax: +27 12 320 4353, e-mail: thulani.mabaso@undp.org and UNDP/RBA New York, Dr. Ademola Salau, regional coordinator for GEF climate change, tel: +1 212 906 5911, fax: +1 212 906 6362, e-mail: ademola.salau@undp.org*
18. Project linkage to Implementing Agency programme(s): *UNDP South Africa and DME are currently jointly implementing another UNDP/GEF MSP project entitled 'Solar water heaters for low-income housing in peri-urban areas in South Africa. Furthermore a Programme Support Document has been prepared to provide overall programmatic support to the North Western Provinces. The here proposed initiative is considered by both UNDP South Africa and DME an excellent addition to the above work focusing on renewable energy, social development (poverty reduction) and business development*

1. Background

Dependence on fuelwood

Fuelwood is the traditional energy source for cooking in many countries of the developing world. Especially in dry zones of the African continent many people suffer from the increasing scarcity of fuelwood. High population pressure, erosion and deforestation cause severe environmental degradation and fossil fuel-based cooking fuels exacerbate poverty and impact negatively on local economies. South Africa is more fortunate than most countries on the Sub-Saharan continent, but still experiences its own crises which primarily affect the rural poor. Baseline information from the National Biomass Initiative completed in 1995 showed that only in areas of high rainfall there were no problems in fuelwood supply. Elsewhere there are periodic droughts and pressures of residential settlement and agriculture have caused deforestation and soil erosion. The country has embarked upon a national audit to determine the effects of desertification. In addition the use of fuelwood generates smoke, often indoors, being a major cause of acute respiratory illness with children, women and the elderly.

Problem of cooking energy in rural South Africa

Generally, poverty implies, amongst other things, limited access to energy sources. Energy, in the household, is required for cooking, heating of water, lighting, refrigeration and space heating. Energy issues need to be viewed against the broader background of poverty which often influences and dictates energy choices of households. Households are dependent on unreliable and unpredictable sources of income and various needs, of which energy is only one, have to be met within these constraints. Low and unreliable incomes perpetuate households' dependence on energy sources that are either free (such as woodfuel) or which can be purchased in small quantities on a daily basis. In rural areas of South Africa wood accounts for over 75% of fuel consumed and it is estimated that 10 million tons of fuelwood are used in rural areas every year. In most rural areas, wood is collected, predominantly by women and children, as a "free good" but increasing trends of fuelwood commercialisation by men are emerging. Between 40% and 80% of rural households collect wood, with over 65% of collection trips being undertaken at intervals of a week or less, with an average trip lasting 4 hours. Wood is bought for fuel by between 30% and 40% of households in rural areas with many relying on remittances from urban-based family members to do so. Commercial fuelwood is delivered predominantly in truckloads, but also in bags, head-loads and bundles at varying prices.

Solar cooking and baking as an alternative

The only free energy source which could compete with wood is solar energy. Solar cookers have been in the development stage for some time, but only recently has there been an effort to make them economically viable. South Africa experiences some of the highest insolation in the sub-Saharan region, which makes it an excellent geographical location to use solar cookers. The potential to use the Sun's energy for thermal energy purposes is significant. The Northern Cape has an annual daily average insolation of 6100 Wh/m^2/day (Watthours per square metre per day) with very low precipitation. 10 year average figures for sunshine vary from a low of 8.6 hours in June, rising to 11.3 hours in January. The North West Province has an annual daily average insolation of 5700 Wh/m^2/day with less than 450 mm precipitation, falling between January and March. 10 year average figures for sunshine vary from 8.1 hours in February to 10 hours in July[1].

Multiple fuel use, or the practice that utilises a range of fuels and appliances at the same time or interchangeably because of their availability and accessibility, is the norm in most developing households, also in rural areas. The use of multiple fuels or "fuel switching" is mainly influenced by

[1] Data from the SA Weather Bureau and Cowan (1992) cover the entire country on a regional basis.

survival concerns. The use of solar cookers fits in with the multiple fuel use pattern of households: people are used to switching between fuels and appliances and the availability of solar cookers represents a broadening of choices to women in terms of satisfying their cooking requirements.

International experience with solar cookers

In the 1970's and 80's, solar cooker developments were plenty. In India, a state subsidy triggered the sale of over one hundred thousand solar box cookers for families. Smaller, mostly non-commercial dissemination programmes were conducted in Kenya, Pakistan, Costa Rica, and other countries. A number of unsuccessful dissemination attempts took place, inter alia in Mali and Sudan. At the same time, different types of large solar cooker models for institutions were developed and disseminated in small numbers. By the end of this period, over 150 different types of solar cookers had been catalogued. Success or failures of the different attempts are hard to establish, given the striking contrast between enthusiastic self-evaluations and the more differentiated and sometimes gloomy findings of independent studies which frequently reported technical problems and low use figures. The reasons for failures were readily identified: lack of means, low technological development level (concerning cooker performance, handling and durability), lack of interest for and adaptation to user conditions. As for the frequently cited problem of high price, it can safely be mentioned that most of the cooker models would have been failures even at zero price. By the late 1980's, in the midst of continuing enthusiasm of cooker designers for their own designs, solar cooking had lost much of its credibility in technical development circles, was criticized for its top-down approach and looked upon as a solution looking for a problem.

But solar cooking bounced back. The general public continued to believe that solar energy where it is most abundant must be able to contribute somehow to a solution to the cooking fuel crisis. Finally, solar cooker proponents ended up learning from failure and criticism and turned towards a more pragmatic, co-operative, and problem-oriented approach. Recently, the dissemination of several ten thousands of concentrator cookers in Tibet has been reported (Integration:1997). In some parts of the country the market is reported even to be saturated. In South Africa, individuals have experimented with solar cooker designs, but no commercial activity was associated with solar cooking before the SunStove Organisation started disseminating the SunStove in 1993. A number of role-players with design, manufacturing and marketing skills have been identified with the possibility of drawing on existing expertise and distribution networks.

White Paper South African Energy Policy

According to the White Paper on Energy Policy of the Republic of South Africa, which was approved by Cabinet on 2 December 1998: "The energy sector has larger environmental impacts than most other economic sectors, with associated greenhouse gas emissions feared to be a major contributor to global warming. Energy policies are already responding to pressures to reduce emissions as energy investments are subjected to greater environmental scrutiny. [...] The research and development of alternative and renewable energy sources is also being promoted[2]. As a signatory to the UNFCCC, South Africa intends to play a constructive role in the alleviation of environmental emissions". The White Paper on Energy Policy sets objectives and specific priorities of the South African energy policy within the broader policy framework of the Government's Reconstruction and Development

[2] The South African Government promotes R&D of alternative and renewable energy activities by means of jointly financing R&D activities (like the solar cooker initiative under attention), conducting pilot projects, supporting the organisation and implementation of renewable energy workshops, symposia etc. For example, in November 2000, DME organised an 'International conference on solar cooking in South Africa' (free of charge for participants). The level of support and promotion of renewable energy that the Government of South Africa can give is limited by their financial and human resources (DME is seriously understaffed as it concerns staff available for renewable energy activities.

Programme (RDP). Among the objectives of the sector are: a) Increasing access to affordable energy services, b) Improving energy governance, c) Stimulating economic development, d) Managing energy-related environmental and health impact; and e) Securing supply through diversity.

The proposed project supports the overall energy sector policy, including all objectives mentioned above. The Government believes that renewable energy can in many cases provide the least cost energy services, particularly when the social and environmental costs are included, and will therefore provide focused support for the development, demonstration and applications of renewable energy. Furthermore, the project would lead to the introduction of a new technology and possibly new industry into South Africa with some potential for job creation, an important goal of Government's Growth, Employment and Redistribution (GEAR) strategy. Part of South African Energy Policy is conducting pilot projects in order to promote the use of renewable energy resources and appliances.

2. South African solar cooker programme: Phase I – User Acceptance

In 1996 a joint solar cookers initiative from the Government of South Africa and the Government of the Federal Republic of Germany was set up to investigate the solar cooker potential to reduce problems related to the supply and use of cooking fuels in mainly peri-urban and rural areas. This led to two main questions to be answered:

- If people have access to solar cookers, do they actually make use of them?; and
- Once solar cookers are commercially produced and distributed, will they find clients willing and able to buy them?

If the answer to the first question is "no", solar cooking will remain a minority phenomenon, confined at best to a small number of enthusiasts and/or to very specific situations (such as absolutely desperate fuel shortages as is for example the case in refugee camps). If the answer to the second question is "no", solar cookers will have to be subsidised, which limits their potential for massive and cost-effective application. On the other hand, if the answer to both questions is "yes", this indicates an opportunity for wide-spread commercial distribution. The project has two phases, with the second phase being dependent on the success of the first. The objectives of the two phases are:

> Phase I: To test the end-user acceptance (in households and at institutions) of different types of solar cookers in three communities within South African test areas; and
>
> Phase II: To investigate the possibilities of a commercial dissemination of solar cookers to institutions and households in the regions of these test areas.

Phase I of the project, undertook the following actvities: a) A baseline study to select three areas (villages/township) with institutions and twenty families per area as an experimental group; b) Selecting a control group of families not using solar cookers; c) Selection and training of three monitors from each of the three study areas to assist in the field test (data gathering and technical support); d) Placing cookers with willing families and institutions and train them on their use; e) Evaluating, through both quantitative and qualitative means, the use of the cookers, fuel consumption and other important information including similar data from the control group; f) Contacting key role players and stake holders in (e.g. aluminium) industry in Germany and South Africa; and g) Establishing, in parallel, a preliminary overview of the market conditions (manufacturer, retailer, transportation networks and credit availability) and perceptions toward possible commercialisation of solar cookers.

The key messages from Phase I that directly relate to the user acceptance – and subsequent use – of solar cookers were:

- The high use-rate of solar cookers, at par with wood and above other fuels, indicates acceptance of solar cooking by families;
- Each type of cooker has its own supporters. An obvious universal, single choice does not emerge. However, clear user preference for certain cooker types is evident and thus provides a sound basis for the selection of solar cookers to be promoted during Phase II of the Project;
- Considerable fuel and time saved by the use of solar cookers generate reasonable pay-back periods except for the most expensive cookers;
- The willingness to buy test cookers suggests a viable market for solar cookers; this is confirmed by the findings of an independent market study; and
- While causing a shift in cooking times and a re-organisation of household labour, the use of solar cookers does not disrupt social relationships.

The first phase ended in 1998/1999 and spent a total budget of US$ 1.6 million provided by the German Government (US$ 1.5 million) and DME (US$ 100,000). The main outcomes of phase I form the basis for the proposed initiative. In Annex 1 the executive summary of the phase I report is presented. More detailed information can be found in the main report of Phase I entitled 'End-User Acceptance; solar cooker field test in South Africa', jointly published by DME and GTZ as well as on the website set up for this project: www.solarcookers.co.za. Results from Phase I made it possible to answer both questions posed above in the affirmative and it was recommended to enter into Phase II, for which UNDP/GEF assistance is being requested in addition to the already allocated financial resources from the German Government.

Phase II of the solar cooker project has already started in 1999/2000 and it is anticipated that until UNDP/GEF funding has been approved, allocated and available to the project management unit an amount of US$ 1.6 million will have been spent on phase II activities[3]. Hence these are not included in the budget presented in section 10. In summary an amount of US$ 3.2 million has already been spent on the solar cooker programme the past years therewith providing a solid basis for the proposed initiative for which UNDP/GEF funding is requested.

3. Rationale and objectives

In South Africa there is a clear need to address the cooking and baking problems (see section 1. Background) as experienced by many households and institutions in peri-urban and rural areas. Many international assistance programmes focus on the provision of modern energy services (electricity), which have little to no impact on the energy requirements for heating, cooking and baking. The results from phase I of the solar cooker programme, indicate that solar cooking and baking can be considered a viable alternative to be included in the 'multi fuel use pattern' of households and institutions in the target areas. Especially the results of the thoroughly tested user-acceptance are promising as this has in the past often proven to be the most important element of solar cooker introduction and dissemination.

[3] Phase II activities focus on up scaling the activities as they have been designed and implemented in a small number of field test. The test area only consisted of three test areas, whilst phase II activities cover an area with 500,000 households in the North-Western part of the country. Main contents of activities undertaken prior to the start of the UNDP/GEF supported MSP activities are on creating solar cooker awareness and acceptance (although much more work on this is required to reach a substantial market – for this UNDP/GEF assistance is requested), introducing the preferred solar cooker types from the test phase, distribution infrastructure for solar cookers has been designed and partially implemented, technology transfer for the (larger-scale) local production of solar cookers has been initiated and an international conference on solar cooking has been organised in November 2000.

The proposed project is designed to remove barriers to the widespread use of solar cookers at household and institutional levels in peri-urban and rural areas. The proposed project meets all the elements included in the country's energy policy and South Africa is eligible for GEF support as a result of their ratification of the United Nations Framework Convention on Climate Change (UNFCCC) on 29 August 1997. The Government states that the ratification "confirms South Africa's standing within the international arena as a country that is responsible for environmental management and sustainable development and that commits itself to those parts of the Convention which apply to developing countries."[4]

Objectives

This proposal focuses on the pilot production and commercial dissemination of solar cookers in South Africa, more specifically in the Northern Cape and North-West Provinces (target areas). The main objectives of the proposed project are to:

1. Remove barriers that currently hamper the local manufacturing, retailing and provision of after sales services for different solar cookers;
2. Remove awareness and information barriers existing with end-users in the target areas as well as with other stakeholders involved in the further development of solar cooking and baking;
3. Assist in removing technical, organisational, information and possibly financial barriers related to the geographical spreading and/or up-scaling of the proposed initiative.

The initial focus will be on the target areas mentioned above, but as part of the proposed initiative information on the anticipated successful programme will be systematically shared with other provinces in South Africa as well as with other SADC countries who have already shown interest (Namibia, Zimbabwe, Malawi, Tanzani and 'Uganda').

4. Barriers preventing pilot production and commercial dissemination of solar cookers

Although the potential of solar energy for cooking and baking is often recognised, few successful activities have been designed and implemented to sustainably harness this potential; i.e. providing sufficient incentives for actors to get and stay involved. Various barriers are preventing the operationalisation of this potential, namely (in no particular order):

- *Technical:* limited skills in the design and production of different solar cooker models with potential local large scale producers; limited (rural) local skills in the modification and repair of different solar cooker models; limited skills and knowledge on how to set up a large-scale manufacturing process and facility for different solar cooker models.
- *Institutional barriers:* limited institutional set-up in the target areas that supports the development and implementation of the proposed initiative; local retail/distribution channels are not adapted yet for including different solar cooker models in their activities; no after-sales service infrastructure for solar cookers exists.
- *Information barriers:* limited awareness with potential end-users outside the test community addressed in phase I; limited awareness with potential manufacturers, suppliers, retailers on the commercial possibilities of the solar cooker business; product information and how to properly use the product is available only with a limited number of people who where involved in phase I;

[4] Government Notice, Department of Environmental Affairs and Tourism No. 1676 "Ratification of the UNFCCC", 19 December 1997.

limited reliable information on the positive impacts of using solar cookers on the local environment, including indoor pollution.

- *Cultural barriers:* cooking and baking making use of solar energy is new and contrasts with the traditional way of cooking with biomass and/or parrafin, gas, electricity resulting in natural resistance; similar for the required changes in cooking habits, among others the time of day for cooking.
- *Financial barriers:* initial investment for some solar cooker models is relatively high for low-income households; not one potential manufacturer is willing to invest on his own in the development of a solar cooker manufacturing infrastructure required for developing and servicing a solar cooker market.
- *Policy and regulatory barriers:* despite of the existence of South Africa's White Paper on Energy Policy, clear and fully developed instruments to implement this policy hardly exist.

Many of these barriers have already been addressed during Phase I of the solar cooking programme, however this was with a relatively small test community. Hence the majority of these barriers still exist when dealing with the target area as a whole, but lessons learned from phase I will make addressing these barriers more efficient.

5. Expected project outcomes

The expected results of the successful implementation of the proposed initiative will facilitate the dissemination of 50,000 solar cookers in a 6 year period. More specifically:

- 3-4 Solar cooker models will have been designed, proto types produced in Europe and transferred to South Africa for mass production;
- Mass production processes have been designed, tested and implemented in South Africa for the manufacturing of 3-4 solar cookers models;
- 2,000 Solar cookers will have been produced/distributed the first 2 years of project implementation;
- Manufacturing and distribution, sales channels capable of mass dissemination of solar cookers have been adequately developed;
- Awareness among key stakeholders (rural women) about the potential, availability and affordability of solar cookers has been significantly increased in the target areas;
- 50,000 Solar cookers, i.e. 10% of the households in the target area, will have been disseminated in a 6 year period;
- Information packages for stakeholders and interested others outside the target areas, even in the SADC region, have been prepared and presented during 2-3 (international) workshops;
- Human and institutional capacity for continued development of the solar cooker sector has been substantially strengthened;
- A policy context, including policy instruments conducive for accelerated solar cooker development and dissemination has been designed and developed; and
- Direct fossil fuel savings as a result of the dissemination and use of 50,000 solar cookers, with a lifetime of 5 years ranges from 135,000 to 225,000 tonnes of CO_2; i.e. 37,000 to 61,000 tonnes of Carbon. Incremental cost investment is US$ 800,000, thus the Unit Abatement Costs of the proposed initiative ranges from US$ 13 to 22 per tonne of Carbon. See annex 2.

6. Activities to remove the identified barriers

Two levels of activities are generally required for the development and dissemination of a 'new technology', process and/or approach. Firstly activities mainly at a controllable level, thereby addressing the type of barriers as indicated before, but on a limited scale only; i.e. a pilot programme in

a restricted target area. Secondly, activities that put in place the conditions required for the replication of a pilot programme. Often the latter activities are nation-wide and build on the outcome of the pilot project. The proposed initiative will focus for the first two years on the realisation of a successful pilot programme after which the third year will focus on putting in place the conditions for the replication of the pilot programme beyond the target areas and possibly even beyond South Africa.

6.1. Pilot level intervention

The current development status of the market for solar cookers in the target areas dictates that the following (marketing) components will form the backbone of the proposed GEF pilot level intervention in order to remove identified barriers; product quality improvement, awareness and promotion, price reduction and affordability.

Component on Product Quality Improvement
The product referred to here is more than just the solar cooker device. It also includes the availability of the product at local sale outlets as well as maintenance and/or after sales services. Improving the quality of the product requires interventions at two distinct levels. First, for large-scale manufacturing of different solar cooker models locally, design and production skills need to be improved through extensive (on-the-job) training. Similar is the case for local workshops to be involved in the modification and/or repair of solar cookers. Part of the manufacturing infrastructure activities will be providing support to set up an internal quality control system and to monitor it. The first small batches (~ 100 units) of solar cookers will be designed and produced in Europe after which the product and process technology transfers will take place to South Africa. After this large-scale manufacturers will be contracted to produce 500 solar cookers the first year and 1,500 the second year of the project, during which they will receive assistance as indicated above.

Secondly, functioning distribution channels for the different solar cooker models need to be established and people active in these channels properly capacitated to deal with this new product. It is anticipated to make use of already existing distribution channels for household devices rather than setting up a new infrastructure. An after sales service programme will be designed and implemented, with the provision of training for manufacturers, local workshop staff, retailers and shop owners as appropriate. The set up of a consumer feedback mechanism will be part of the after sales service programme to ensure that customer needs are fully integrated.

These activities mainly address the technical and institutional barriers. It is estimated that the activities related to the large-scale manufacturing will cost US$ 370,00 and will build on activities already implemented by making use of resources from the German Government (US$ 400,000). GEF is requested to provide this amount of US$ 370,000. Activities related to setting up a distribution channel and after sales service are estimated to cost US$ 400,000 fully paid for by already allocated project funds from the German Government.

Component on Awareness and Promotion
Lessons learned from phase I have led to include a substantial awareness and promotion campaign in phase II, as this is being regarded on of the main success factors in the dissemination of solar cookers. An awareness campaign and marketing strategy will be developed and implemented in cooperation with the commercial and other partners in the target areas. Specific activities will include a) PR events with key role players, b) a media kit, c) a mobile demonstration unit, d) on-site cooking and baking demonstrations, and e) advice and support to commercial partners on marketing and after sales issues. In addition the effectiveness of the awareness and marketing campaign will be closely monitored, such

that it can be adapted as needed at early stages of implementation. In order to also address political barriers, information packages will be prepared to raise awareness at DME on the potential of solar cookers and to assist DME and other appropriate Government agencies in preparing appropriate policy instruments to further the development of solar cooking in South Africa.

These activities mainly address the information and cultural barriers and to some extent the political barriers and are fully incremental. It is estimated that these activities will cost US$ 335,000 proposed to be paid for by GEF (US$ 285,000) and the South African Government, DME (US$ 50,000 cash/in-kind).

Component on Price Reduction and Affordability

One of the direct results of the larger-scale manufacturing is the substantial reduction in price of the solar cookers. Reduction by a factor 1 to 2 is considered realistic on the current prices of 200 to 250 Rand for a 'slow cooker' and 400-500 Rand for a 'fast, efficient cooker'. See annex 3 for anticipated price developments of 5 different solar cookers. Since also the initial costs for the set-up of retail and distribution infrastructure will be provided through the project, the end-users will pay the production costs for the solar cookers only. It is estimated that this is at a similar level as the cost of solar cookers 2-4 years after the project start, including the sector's overhead costs.

To increase the affordability of the solar cookers, it will be necessary to design and implement a financial mechanism that enables end-users to make a 20-40% down payment followed by 3-5 installments. Use will be made of existing rural financing mechanisms that are already being used for agricultural and household appliances.

This activity mainly addresses the financial barrier and is fully incremental. It is anticipated that this activity will cost US$ 30,00, paid for by GEF. End-users will contribute through the purchase of the solar cookers; i.e. 2,000 solar cookers in years 1-2 with an estimated average price of US$ 30-60, thus US$ 60,000-120,000. US$ 90,000 is taken as the amount to account for the end-users cash contribution.

6.2. Replication of pilot level activities

Activities directly supported by the project; i.e. the manufacture and dissemination of 2,000 solar cookers in a 2 year period, will have to be up-scaled to the level that 10% of the population in the target area will use solar cookers for 25% of their cooking and baking needs. This corresponds with 50,000 households to be reached before the end of 2006. This will start with close monitoring of the pilot level activities in order to distill the elements required for successful replication. A dissemination strategy will be designed in close cooperation with commercial stakeholders and end-users alike in the target area. During the second and third year of the project the dissemination strategy will start its implementation with the following estimated activities; a) continued awareness and promotion, b) pro-active involvement of retail, distribution channels and shop owners, c) recommendations for policy changes and the development of policy instruments to accelerate the dissemination of solar cookers. Other activities will be identified during first year's implementation of this project.

Although not the prime focus of the proposed initiative, also replication of the project's outcomes to other Provinces and even to other SADC countries will be partially facilitated through the preparation and sharing of information packages on the products and processes. In addition 2 national and possibly 1 regional workshop will be organised during the course of the 3-year period of this initiative.

In order for activities to be replicated and/or up-scaled in the target areas and beyond the existence of a stable and experienced project management unit is of utmost importance. The currently existing project management unit set-up for the implementation of phases I and II will be in place till approximately the second quarter of 2002. To ensure continuation of project activities afterwards an exit strategy will be designed and implemented starting mid 2001. See also section 11 for more information on the implementation arrangements of the proposed initiative.

These activities are anticipated to cost US$ 2.41 million including all costs related to project management. This is mainly paid for by the end-users who will contribute through the purchase of the solar cookers; i.e. 48,000 additional solar cookers in years 3-6 with an estimated average price of US$ 30-60, thus US$ 1.44-2.88 million. US$ 2.16 million is taken as the amount to account for the end-users cash contribution. In addition funding comes from the German Government (US$ 100,000), the South African Government, DME (US$ 50,000) and an amount of US$ 100,000 is requested from GEF.

6.3 GEF baseline and monitoring

To monitor the impacts of the UNDP/GEF intervention, it is necessary to create a baseline situation, indicators and a methodology for monitoring changes, followed by actual monitoring changes to be used as an input to the UNDP/GEF evaluation of the proposed initiative. In addition to CO2 benefits also the economic and social benefits from solar cookers are included in the M&E activities. This activity will cost US$ 15,000 and is fully incremental.

7. Sustainability analysis and risk assessment

The philosophy behind the project is based upon the principle of sustainable development; i.e. that such an intervention in energy use by households must be self-sustaining (i.e. commercial). The history of similar projects in other areas of the World is littered with well-intentioned, government-subsidised interventions which have failed for a number of reasons; firstly because once the subsidy has been phased out no mechanism is in place to carry the full cost of production and distribution, secondly because citizens tend to regard free appliances as reflective of poor quality, thirdly because of inadequate monitoring and evaluation, which *inter alia* can lead to absence of quality control, and ultimately a product which does not do the tasks properly. Lack of maintenance facilities, capacity and institutional infrastructure have been documented as contributors to failure. But much information is anecdotal and not systematically collected. The difference with the proposed initiative is that it adopts GTZ's systematic, stepwise approach. At any stage in the process the facts concerning every facet are known; if there is a problem a decision will be made on whether this can be remedied. No further work will be undertaken until this step is satisfactorily completed. The consequences for using this methodology are that should the project fail for some reason, at least the reasons for the failure will be fully documented, so that any later projects may benefit from the experience. However, the progress to date rather points towards a successful outcome.

Over the course of the project, monitoring will assess to what extent the project will be sustainable. For example, initially support costs for both producers and retailers have been factored into the equation as the final costs of limited batch production would be too much for either party to bear, or to pass on to the consumer. In the course of time it is anticipated that bulk sales and an expanding market will render these supports unnecessary. The continuing development of the cookers should also slowly reduce the costs associated with their production.

For several years now the Sunstove has been sold for approximately US$ 25 all over South Africa. The price of the Sunstove is admittedly on the low side, although it is at a level that could be reached the next 5-10 years for improved quality solar cookers as a result of mass production and a properly developed solar cooker distribution channels. However, the combined fact that user-acceptance has proven to be high (results Phase I) and that people are buying solar cookers at cost is the crux of the matter about sustainable commercial production and dissemination which will result in a solar cooker infrastructure having been established by the time the project has finished in the pilot region.

The focus area is relatively small making it possible to focus activities and thereby increasing the possibilities of being successful. Also the number of people that are expected to be reached in the target area; i.e. 10% of 500,000 households is considered a realistic target and might even be exceeded by far if activities will emerge outside the target area in, or even beyond, South Africa. For the programme design and implementation a sound marketing approach is being followed based on a proven product, that will be available at affordable prices for a large target area (500,000 households). Furthermore from the financial resources available to the programme during phases I and II, it can be concluded that it has robust support from both the Governments of South Africa and Germany.

8. Stakeholder involvement and beneficiaries

During the implementation of phase I, consultation workshops were held with and within local communities and other stakeholders in the target areas. The response towards the solar cookers was favourable in that nearly all participants who had used cookers over the 12 month period, and many others who had experienced them from the 'side-lines' as neighbours or relatives, put their names on the 'waiting list' to buy a cooker. Used cookers were offered at a half-price discount. A continued dialogue will be part of phase II, because knowing what customers need is the best basis for meeting customer needs in the most effective manner and this in turn is the best promotion for the solar cooker (programme).

In the local communities the targeted end-users mainly comprise of women in poor rural households. User support structures such as churches, NGOs, CBOs and rural cooperatives will be identified and trained. Because of the innovative nature of the technology and experiences to date it is considered essential that information material on the use of solar cookers is prepared in local languages. In addition to end-users other stakeholders are solar cooker manufactures, retailers and the South African Government. Local and provincial administrations will be encouraged to be involved in project activities (especially in the promotional aspects) as well as major distributors. Lastly also the donors; the German Government and UNDP/GEF are stakeholders, because also for them it will be important to make a positive contribution to the complicated area of providing sustainable cooking and baking services and household and institutions level that can be replicated internationally.

9. Incremental cost matrix

In this table the end-users expenditures on buying solar cookers over the 6 year period have not been included, this in contrary to the budget presented in section 10.

The CO_2 savings potential by wider-spread solar cooker use under 50,000 households in a 6-year period has been estimated at:

	Baseline costs (US$)	**Alternative costs (US$)**	**Incremental costs (US$) (Alternative-Baseline)**
TOTAL PROJECT **Global Environmental Benefits.**	CO2 emissions as a result of continued fossil and unsustainable wood use. Barriers for solar cooker development.	CO2 emission mitigation due to the use of solar energy for cooking. Solar cookers disseminated under market conditions.	CO2 emission reduction- of 50,000 cookers over 5 year ranges from 135,000 to 225,000 tonnes of CO2. Infrastructure in place for future solar cookers development.
Domestic benefits.	Increased pressure on local environment. Unacceptable levels of in door pollution. High cost of cooking fuels for rural population.	Using national renewable resources more optimal. Increase capacity and generate employment in solar cooking manufacturing, retail and servicing.	Employment in production, retail and service infrastructure. Reduced costs of cooking and baking. Improved in-door environment.
Pilot level activities			
Product quality improvement			
- mass manufacturing infrastructure	0	370,000	370,000
- distribution infrastructure	400,000	400,000	0
Awareness and promotion	50,000	335,000	285,000
Price reduction and affordability	90,000	120,000	30,000
Replication pilot activities			
Close monitoring of pilot activities	25,000	25,000	0
Design of dissemination strategy	50,000	60,000	10,000
Implementation dissemination strategy	2,160,000	2,230,000	70,000
Information exchange/workshops	25,000	45,000	20,000
Exit strategy design/implementation	50,000	50,000	0
UNDP/GEF monitoring and evaluation	0	15,000	15,000
TOTAL	**2,850,000**	**3,650,000**	**800,000**

10. Budget (US$)

The amounts mentioned in the budget table are cash contributions to the project. In-kind contributions will be provided as well by especially the DME and the local UNDP Office in Pretoria, but no estimate of that amount has been made and included in the financing structure of the proposed initiative.

Component	**GEF**	**German Government**	**SA Government And End-users**	**Project total**
PDF A:	*0*	*0*	*0*	*0*
Personnel: (International and national)	330,000	300,000	(DME) 60,000	690,000
Training:	110,000	110,000	0	220,000
Equipment:	240,000	0	(End-users) 2,250,000	2,490,000
Travel:	70,000	30,000	(DME) 20,000	120,000
Monitoring and evaluation mission(s):	30,000	50,000	(DME) 20,000	100,000
Miscellaneous:	20,000	10,000	(DME) 10,000	40,000
Project total	**800,000**	**500,000**	**2,350,000**	**3,650,000**

11. Project implementation arrangements and plan

The executing and implementing agency for this project will be the Department of Mines and Energy, who were also the executing agency for phase I. This implies that full responsibility lies with this Department regarding the execution, monitoring and steering of this project. The local UNDP office will administer and allocate the funds of the project on behalf of the GEF Secretariat. Furthermore it will provide assistance on the formal GEF procedures that apply to any administrative requirement and it will be the (formal) channel of correspondence between the project and the UNDP/GEF regional coordinator and the GEF core unit in New York.

The executing agency will set up a programme management unit (PMU) and will appoint a programme manager. It is anticipated that the currently existing implementation infrastructure for phase I and II will serve as a basis for DME to set-up the PMU. Also use will be made of the already existing steering committee meeting that will be complemented with a UNDP/GEF representative and possibly others to be decided by the executing agency. The PMU will work closely with the UNDP office in Pretoria for the implementation of the work plan. As part of the Project Document Phase, the project's detailed implementation plan, work plan and Terms of References will be prepared. The following table presents the first draft of the proposed implementation work plan.

Project implementation work plan

DURATION OF PROJECT IS 3 YEARS												
ACTIVITIES	**PROJECT QUARTERS**											
Pilot level activities:	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Product quality improvement												
- mass manufacturing infrastructure												
- distribution infrastructure												
Awareness and promotion												
Price reduction and affordability												
Replication of the pilot activities:												
Close monitoring of pilot activities												
Design of dissemination strategy												
Implementation dissemination strategy												
Information exchange/workshops												
Exist strategy design/implementation												
UNDP/GEF monitoring and evaluation												

12. Monitoring and evaluation plan

The implementation of the project will be closely monitored in accordance with UNDP established monitoring procedures by UNDP South Africa in consultation with UNDP/RBA and the UNDP/GEF Core unit in New York. The project will be annually subject to joint reviews by representatives of the Government and of UNDP. The first of these meetings will take place within the first 12 months of the full implementation of the project. The programme manager of the project will draft and submit to each review meeting a Project Performance Evaluation Report (PPER). If necessary, additional PPERs may be requested during the implementation of the project. A final report on the project will be submitted for the consideration of the final review meeting. A draft should be submitted at least four months before the final review meeting to be considered by the Government and the UNDP. The project will be evaluated when its implementation is half way through and at the end of the project. During the Project Document Phase the Terms of Reference for the evaluations will be prepared. All

the above to be combined to the extent possible with the strict monitoring and evaluation done by the German Government.

13. Technical review

No STAP review has been undertaken.

14. Project checklist

PROJECT ACTIVITY CATEGORIES			
Biodiversity	**Climate Change**	**International Waters**	**Ozone Depletion**
Prot. Area zoning/mgmt:	Efficient prod. & distribution:	Water body	Monitoring
Buffer zone development:	Efficient consumption:	Integrated land/water:	Country programme:
Inventory/monitoring:	Solar: **X**	Contaminant:	ODS phaseout:
Eco-tourism:	Biomass:	Other:	Production:
Agro-biodiversity:	Wind:		Other:
Trust fund(s):	Hydro:		
Benefit-sharing:	Geothermal:		
Other:	Fuel cells:		
	Other:		
TECHNICAL CATEGORIES:			
Institution building:			
Investments:			
Policy advice:			
Targeted research: **X**			
Technical/management advice:			
Technology transfer: **X**			
Awareness/information/training: **X**			
Other:			

Annex 1

Executive summary of Phase I of the Solar Cooker Programme for South Africa

Introduction

Firewood is the traditional energy source for cooking in many countries of the developing world. Especially in dry zones of the African continent many people suffer from the increasing scarcity of firewood. High population pressure, erosion and deforestation cause severe environmental degradation and fossil fuel-based cooking fuels exacerbate poverty and impact negatively on local economies. Solar cooking could contribute to solving this problem especially in arid regions with sparse wood supply and high solar irradiation. Now, following preparatory work, the Federal Republic of Germany and the Republic of South Africa jointly support a solar cooker pilot programme of which this field test is a part. Its project purpose is: ***"The acceptance and dissemination situation for solar cooking options is clarified and documented within the test area".*** The approach fits in with the efforts on the part of the federal government of **Germany** to improve the extent of basic-needs satisfaction. Moreover, it also contributes toward the implementation of **Agenda 21**. For example, in terms of avoided carbon dioxide emissions, the projected fuel savings due to a large-scale solar cooker programme in the Northern Cape and North-West Provinces would translate in to avoided carbon dioxide emissions of over 45 000 tons per annum. Furthermore, the promotion of the use of solar energy for cooking purposes clearly falls within the identified policy priorities of the **South African** government.

Methodology

A baseline study, targeting the dry North-Western region of South Africa, scanned five potential study areas by interviewing 200 households. Based on criteria like **"cooking profiles"** (weather conditions, fuel availability and prices, household size, availability of appropriate sunny space, cooking techniques and schedule) as well as socio-economic characteristics, three test areas were selected: **Onseepkans** is representative of small rural villages, where collected wood is the primary source of fuel. **Pniel**, though also a small rural village, is located only 8 km from the nearest town; there is a fuel mix with wood and paraffin used in almost equal proportions. **Huhudi**, an urban township, has access to electricity, has a high reliance on paraffin for cooking and a comparatively low use of wood. Cookers were tested by **66 families** and **14 institutions** in the three test areas for a one year "placement period". 30 families (without solar cookers) have acted as a control group. Six types of cookers were placed with families, three each for large and small ones. Each family had one type of cooker for two months before changing and using another. In addition, three large cooker types were placed at institutions where a mix of cookers could be tested. For users and non-users, three different types of **questionnaires** were completed. Moreover, in-depth **interviews** provided additional information. At the end of the placement period, a workshop was conducted in each test area to carry out a preference voting exercise. Finally, waiting lists were established for the **purchase of used cookers** as a useful indicator of user preference.

Technology of Test Cookers

The test included all three basic cooker types (boxes, concentrators, flat plate collector cookers), small as well as large models, elaborate and simple ones. Following a practical use test, all cookers were found capable of preparing the typical dishes in the study areas. Important differences in thermal performance were observed. A technical evaluation focused on safety, user friendliness and reliability: all cookers needed technical improvements which have been proposed to the designers and were mostly implemented. Some cookers required maintenance. After the placement period, part of the cookers were overhauled before they were sold.

Solar Cooker Use

Intensive monitoring over one year of **solar cooker use** by the families in the three test areas showed that **on 38% of all days**, families use solar cookers at least once, and are satisfied with the results of 93% of all solar cooking attempts. Solar cookers, along with wood (open fires, wood-stoves and coal-stoves fuelled with wood combined) are the most used cooking appliances followed by stoves fuelled with gas, paraffin, and electricity. These results indicate **acceptance of solar cookers** by family test users ("acceptance" of solar cookers being defined as "solar cookers are used as much as or more than other cooking options in the house-hold"). There is a main appliance shift of solar cooker users away from all fuel carriers. Since solar cookers were poorly used by the eight initially selected institutions, the field test was eventually limited to those institutions with reasonable use and interest. Thus, only three of the original institutions remained and another six institutions were added in June 1997. The evaluation is to be extended until April 1998. The overriding incentives for solar cooker use were found to be: high motivation of the cooks, management incentives to reduce fuel expenditure and incentives for the cooks to use the cookers. The most important reasons for not using the cookers are: lack of security for the cookers, lack of budget control by the cooks, and control exerted by outside organisations.

Micro-economic Analysis

During the cooker placement period, the participating families enjoyed **38% of overall fuel savings** (with 33% of paraffin, 57% of gas and 36% of wood). Considering the fact, that solar cookers are no "stand-alone" option and that many families use more than one fuel type for cooking, these fuel savings are considerable. In absolute terms, test users have saved almost 60 tons of wood, more than 2 tons of gas, and over 2,000 litres of paraffin. In monetary terms (average monthly fuel savings per family), savings were highest in Huhudi where fuel is mostly bought, and lowest in Onseepkans where collected wood is an important fuel source. Pniel with its intermediate fuel mix falls in-between.

Average monetary savings per family in Rand

	Pniel	Onseepkans	Huhudi
Average monthly fuel expense	R 46	R 31	R 66
Average monthly fuel savings	**R 17**	**R 12**	**R 26**

The micro-economic assessment of the project highlights interesting features: Departing first, from estimated median retail prices for the six cookers ranging from R 180 (SunStove) to R 4,600 (SCHW1), and second, from the common practice to finance purchase of expensive households items via deposits and monthly instalments (regular terms: 30% annual interest, 10% deposit and 24 monthly instalments), monthly instalments would vary between R 10 (SunStove) and R 260 (SCHW1). The pay-back periods for the different cookers range from 8 months to 5 years (2 years being the average), depending on the study area and the cooker type. With the exception of the most expensive cookers, willingness-to-pay is above the estimated retail cash price or the monthly instalments required to finance a cooker over a 24 month period. Practically **all user families have bought** or ordered **cookers**. Interest to buy solar cookers has also been confirmed by an independent market survey.

Family User Preference

The preference of family users for different cooker types was assessed in three independent ways: by **use frequencies** of the six cookers (SunStove, ULOG, REM5, SK12, REM15, SCHW1), by the **sales of the used test cookers**, and by user workshop **voting results**. According to the first criteria, small families prefer REM5 (over ULOG and SunStove), large families SK12 (over SCHW1 and REM15). These priorities have been confirmed by the sales of the used test cookers while the workshop voting generated a slightly different ranking. Over all three test areas large families mostly

used and bought the REM5 but voted for ULOG as the best cooker, while large families preferred the SK12 with the REM15 coming first in votes.

Socio-Cultural Context

The solar cookers have been tested in complex social environments characterised by poverty, high levels of migration, low levels of production and lack of institutional support. Impacts on women at the household level include monetary savings, which have enabled them to allocate finances to their spheres of influence, as well as time savings which provide the opportunity for them to spend more time strengthening their social networks. However, increased engagement in community politics was not identified. Fuel strategies adapted to cope with poverty are not abandoned completely but adapted slightly. Preference amongst users of solar cookers varies from one household to the other. If an elderly person or a child is responsible for cooking, criteria will relate to manoeuvrability of the stoves. Safety is a key issue, especially for women.

Macro-Economic Impacts

The macro-economic analysis complements the micro-economic assessment and sheds light on likely economic and social impacts once a large scale solar cooker dissemination will take place. Impacts include cumulative savings, reduced air pollution from wood use, and the avoided time used for wood collection. In addition, further effects might be employment increases, slight reduction in air pollution from coal combustion, paraffin poisoning cases, as well as fires and burns from paraffin. Moreover, small decreases will occur in the emission of greenhouse gases (GHGs) such as carbon dioxide: ignoring the production process of solar stoves themselves, the introduction of the solar cooking technology would reduce the amount of wood, paraffin, gas and coal which is burnt.

Conclusions and Recommendations

The key messages from Phase I of the Project are:

- **Solar energy is a promising option** capable of being one of the leading energy sources **for cooking;**
- The **high use-rate of solar cookers**, at par with wood and above other fuels, **indicates acceptance** of solar cooking by families;
- Each type of cooker has its own supporters. An obvious universal, single choice does not emerge. However, **clear user preference** for certain cooker types is evident and thus provides a sound basis for the selection of solar cookers to be promoted during Phase II of the Project;
- Considerable fuel and time saved by the use of solar cookers generate **reasonable pay-back periods** except for the most expensive cookers;
- The willingness to buy test cookers suggests a viable market for solar cookers; this is confirmed by the findings of an independent market study;
- While causing a shift in cooking times and a re-organisation of household labour, the use of solar cookers does not disrupt social relationships;
- Macro-economic impacts are positive;
- The questionnaire methodology concerning family use has proven sound. For institutions, direct observation by the project staff was used;
- All test cookers needed technical improvements and have undergone a first adaptation; the adapted cookers could serve as a basis for local production; and
- The **open methodological approach** where users can express their judgement of a technology in general, and preferences concerning different appliances in particular, **has proven valid.**

These positive conclusions, in particular regarding the micro and macro-economic impact, are the basis for **recommending the implementation of Phase II** of the Project ("commercial pilot dissemination of solar cookers"). In doing so, due consideration should be given to a series of aspects:

- The **co-operation with commercial partners** (manufacturers, distributors and retailers) should be established from the start. Existing distribution channels and financing schemes should be used;
- Given the results of the micro-economic analysis, no subsidies will be needed for the commercial dissemination of solar cookers. However, **specific introduction costs** (unavoidable in the start-up phase of any industrial technology when the products are manufactured and marketed in small quantities) should initially be borne in part by the project;
- The **cooker designs should be further adapted** in a joint effort with designers and local manufacturers. Quality control and transformation of feed-back from users, distributors and retailers should be stressed as essential success factors; and
- Given their good use, voting and sales results, the **e'SHISA, ULOG and SK12**, as well as the easy-to-handle **SunStove**, should be the preferred solar cookers for local production.

The **momentum of Phase I of the Project should be maintained when implementing Phase II**. To bridge the gap between the phases, various features should be maintained: First, production of media (video) presentations - one for general audiences and one for end users (in English, Afrikaans and Setswana); second, preliminary work on the possibilities of local production and dissemination by establishing further links with manufacturers, retailers and other support organisations (like NGOs); third, the availability of end user credits for future solar cooker purchases; and fourth, contacts with manufacturers (e.g. aluminium industry) to both keep them informed of the project progress and to establish potential support for local production.

Annex 2

Assessment of the impact of Carbon dioxide emissions as a result of the proposed initiative

Procedure

In the framework of Phase 1 of the field test, the fuel savings through solar cooker use were determined (see Main Report Phase 1) for 66 cooker user families. Results were determined by direct observation using the GTZ-HEP fuel performance test; they are shown in Table 1.

Fuel type	Yearly Savings, 66 Households (t/y)
Kerosene	1,6
LPG gas	2
Wood	60

Table 1: Fuel savings in Phase 1 in t/y

For kerosene and LPG, these savings were simply converted into avoided CO_2 (Kerosene CO2 emission is 3.2 kg CO2/kg and LPG CO2 emission is 3 kg CO2/kg). For wood (Wood at 25% MC the CO2 emission is 1.6 kg CO2/kg), the situation is more complicated: the *gross* CO_2 reduction caused by wood savings has to be converted into the *net* reduction, taking into account *i.a.*:

- the part of the burnt wood replaced by plants acting as CO_2 sinks;
- the burning of dead wood which would rot otherwise;
- remaining roots;
- non sustainable wood harvesting;
- influence of sub-tree vegetation, etc.

These factors influence the results and are difficult to quantify. The main question is the amount of wood burned and not replaced by equally CO_2 absorbing trees or other plants. Figures such as 25 to 50 % are being mentioned by experts for the dry parts of South-Africa (Fritsche, Liptow, private communication by Dr. Michael Grupp, 2001).

The CO2 balance of the proposed initiative

In table 2 the estimated annual CO2 impact as a result of the proposed initiative are presented, taking into consideration the uncertainties as they relate to the sustainability of the wood that will be saved as a result of the introduction and use of the solar cookers. An extrapolation from 66 households (study group) to 50,000 households (target group for a 6-year period) has been conducted and presented in table 2.

Estimate annual CO2 impact caused by fuel savings of the proposed initiative			
Fuel type	Net CO2 reduction 66 households (t/y)	Total CO2 reduction all fuels combined (t/y)	Total net CO2 reduction 50,000 households (t/y)
Kerosene	5		
LPG	6		
Wood 25%	24	35	26,515
Wood 50%	48	59	44,697

Conclusions

The CO_2 savings potential by wider-spread solar cooker use under 50,000 households in a 6-year period has been estimated at:

- 27,000 to 45,000 tonnes per year. The reason for the factor 2 uncertainty in the results is mainly due to the locally diverse CO_2 balance of firewood use. For the case of 26,500 tonnes per year, 25% of the saved wood is sustainably grown/harvested. For the case of 44,500 tonnes per year this percentage is 50%;
- With a anticipated lifetime of a solar cooker of 5 years, the total direct savings as a result of the successful implementation of the proposed initiative range from 135,000 to 225,000 tonnes of CO2; i.e. 37,000 to 61,000 tonnes of Carbon
- Total incremental cost investment through GEF is US$ 800,000, thus unit abatement costs range from US$ 13 to 22 per tonne of Carbon.

Annex 3

Historic (1996) and anticipated price developments of 5 different solar cookers

		1996		2000		
		Dm	**Rand**	**Rand**	**Mass production 10,000 units**	**Mass production 10,000 units**
1	Izola	395.00 DM	R 1,120.00	R 880.00	R 500.00	US$ 63
2	(Rem 5) T16	624.00 DM	R 1,760.00	R 990.00	R 450.00	US$ 57
3	Ulog	490.00 DM	R 1,380.00	R 425.00	R 380.00	US$ 48
4	Sunstove	- DM	R 150.00	R 200.00	R 200.00	US$ 25
5	Schwarzer 1m2 - collector	2,800.00 DM	R 7,900.00	R 3,800.00	R 2,500.00	US$ 315
		Exchange rate 1 DM = 0.354 Rand		Exchange rate 1 DM = 0.2707 Rand		Exchange rate 1US$ = 7.95 Rand
		04/20/1996		03/09/2001		05/18/2001