

ジンバブエ
鉦工業プロジェクト形成基礎調査
報告書

1994年10月

国際協力事業団

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鉦調計



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ジンバブエ

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ジンバブエ：プロジェクト形成基礎調査（太陽光発電地方電化）
報告書目次

1. 調査の概要	1
1) 調査の背景・目的	1
2) 調査期間	1
3) 調査団構成	1
4) 調査日程	2
5) 案件の調査内容	2
6) 面会者リスト	3
7) ジンバブエの電力事情	4
8) 協議概要	4
2. 資料リスト	
1) Global Environment Facility (Project of the Government of Zimbabwe)	38 - UNDP -
2) Global Environment Facility (Photovoltaics for Household and Community Use)	40 - UNDP -
3) Accelerators of Development	69 - UNRFNRE -

I 調査の概要

1. 調査の背景・目的

ジンバブエはアフリカ南部に位置する国で、周囲をザンビア、南アフリカ、ボツワナ、モザンビーク等と国境を接する内陸国で約1000万の人口の98%をアフリカ系黒人が占める。この国は年間日照時間：3000時間、日射量は2,200kwh/m²に及ぶ世界でも有数の太陽光発電に適する自然条件を備えた国である。

社会経済条件についても、南アを除く他のアフリカ諸国には見られないような製造業・農業がバランスよく発達した経済基盤を持ち、国内で必要とされる消費財はほぼ自給できる程の工業力を有している。また経済インフラも比較的良好に整備され、発達した金融・流通制度・質の高い労働力を備えており、初等教育の就学率は100%を超え、15才以上の成人の識字率は60数%と他のアフリカ諸国をはるかにしのぐ数値を誇っている。

一方同国は、政府機関が配電網拡張計画を推進しているにもかかわらず、地方在住の約800万の住民のうち、配電網による電化の恩恵を受けているものは約0.2%にとどまっており、地方住民の電気に対する潜在的欲求は高いと推測される。

かかる状況のもと、過去数ヶ国で太陽光発電プロジェクトの経験を持つJICAは同国における太陽光発電による電化（特に地方部）に着目、本年8月に現在同国内で実施されているUNDPによる太陽光発電プロジェクトの進捗状況や実施上の問題点等を聴取することを目的にニューヨークにあるUNDP本部へ第1次プロジェクト形成基礎調査団を派遣した。

その後9月にはジンバブエに第2次プロジェクト形成基礎調査団を派遣、ジ側政府関係各機関と太陽光発電（地方電化）プロジェクト実施の可能性について意見交換するとともにJICA開発調査スキームの仕組み、アウトプットについて説明した。また同調査団が作成した本件協力（案）を基に、調査の範囲・先方実施体制等について協議を行い、今後の協力の枠組みを明確にした上、外交チャンネルを通じた正式要請書の提出を促した。

2. 調査期間

第1次プロジェクト形成基礎調査	1994年8月8日～1994年8月13日
第2次プロジェクト形成基礎調査	1994年9月11日～1994年9月26日

3. 調査団員構成

(第1次調査)

・下村 則夫	(団長/総括)	国際協力事業団鉦工業開発調査部資源調査課長
・井本 浩之	(調査企画)	国際協力事業団鉦工業開発調査部資源調査課

(第2次調査)

・棚橋 滋雄	(団長/総括)	国際協力事業団鉦工業開発調査部長
・下村 則夫	(協力計画)	国際協力事業団鉦工業開発調査部資源調査課長
・武山 松次	(電力計画)	通産省公益事業部技術課
・田代 直人	(太陽光発電)	新エネルギー・産業技術総合開発機構太陽技術開発室
・鈴木 武	(技術協力政策)	外務省経済協力局開発協力課
・尾崎 洋二	(企画・調整)	国際協力事業団鉦工業開発調査部計画課

4. 調査日程

(第1次調査)

- 8月8日(月) : ニューヨーク着
- 8月9日(火) : UNDP本部との協議
- 8月10日(水) : UNDP本部との協議
- 8月11日(木) : UNDP本部との協議
- 8月12日(金) : ニューヨーク発

(第2次調査)

- 9月13日(火) : ハラレ着、大使館表敬/打ち合わせ
Ministry of Finance, Planning Commission訪問
- 9月14日(水) : UNDP Harare、PMU(Project Management Unit)との協議
- 9月15日(木) : ZESA(Zimbabwe Electricity Supply Authority)との協議
(棚橋団長、武山氏のハラレ着)
Ministry of Transport & Energy, Department of Electricity
との協議
- 9月16日(金) : SEIAZ(Solar Energy Industry Association in Zimbabwe)
との協議及び関連工場見学
- 9月17日(土) : 資料整理
- 9月18日(日) : 資料整理
- 9月19日(月) : 大使館との協議(鈴木団員着)
- 9月20日(火) : 現地調査(Mt. Darwin)
- 9月21日(水) : DOEとの協議
- 9月22日(木) : DOEとの協議、
- 9月23日(金) : 大使館報告

5. 調査案件の調査内容

- a) Backgroundとしての政治、経済、社会事情
 - ・電化に対するニーズ、政策としての地方電化
- b) 電力事情
 - ・現状、需給見通し
 - ・電力開発計画
 - ・配電、地方電化の現状
- c) 「ジ」国における太陽光発電
 - ・ジ政府の太陽光に対する考え方
 - ・ZESAの太陽光に対する考え方
- d) UNDPプロジェクト
 - ・UNDPの太陽光に対する協力量針、考え方、協力実績
 - ・プロジェクトの概要、現状調査
- e) 村落調査(UNDPプロジェクトによるPV電化済家庭、施設などの調査)
- f) PV業界の現状聴取
 - ・企業数、内容
 - ・生産能力

6. 面会者リスト

(第1次調査)

・ UNDP本部

Mr. Johann Baumier	Deputy Director, UNSFTD
Dr. Suresh Hurry	Senior Technical Adviser, UNSFTD
Dr. Charles Ian McNeill	Special Project Officer
Mr. Carlos Lopes	Ex-Deputy Resident Representative, UNDP HARARE

(第2次調査)

・ 在ジンバブエ日本国大使館

小西 正樹	大使
岡本 治男	公使
大橋 巧	参事官
小路 康雄	一等書記官

・ National Economic Planning Commission

MR. V NYATHI	Deputy Director
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・ Ministry of Finance

MR. O MATSHALAGA	Under Secretary
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・ United Nations Development Planning, Harare

MS. PETRA LANTZ	Deputy Resident Representative
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・ PMU (Project Management Unit)

Dr. G MANDISHONA	Project Manager
MR. C J PFAIRA	Project Coordinator
MR. G MARAWANIKA	Outreach Advisor

・ DOE (Department of Electricity; Ministry of Transport and Energy)

MR. C. T. MZEZEWA	Director of Electricity Principal Energy
MR. B WADESANGO	Conservation Officer
MR. J T CHIGWADA	Assistant Director
(R & D)	
MS. L MUGUTI	Principal Energy Development Officer

・ SEIAZ (Solar Energy Industries Association of Zimbabwe)

DR. D DZENGA	Chairman
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・ Solarcomm (モジュールの組み立て企業)

MR. R Hill	Sales Manager
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7. ジンバブエの電力事情

a) 電力供給組織

エネルギーの供給・需要の管理政策に関しては、運輸・エネルギー省が管轄しており、運輸・エネルギー省の監督下にあるジンバブエ電力公社（ZESA）が電力の供給を行っている。

b) 電力源

ジンバブエの電力は大まかに言って、総発電電力量は約10000（GWh）であり、水力・火力・輸入の電力供給比率は約3：5：2となっている。

c) 配電設備

ZESAの基本的な配電電圧は33kVであり、全長は7,000km、総変電容量は1250MVAである。これは主として、地方の配電のために11kVに降圧され、需要家の構内への供給のために400Vに降圧される。11kVの配電網は合計で27750kmであり、400Vの配電網は11868kmである。

d) 地方電化

ジンバブエでは、約320000の需要家に電気が供給されており、一般家庭の約20%が電化されている。高密度住宅地域に電化の重点が置かれ、次いで学校、商店、地域開発地点となっている。

e) 需要予測

電力消費は1992年の早魁以前の5年にわたり、1年当たり平均3%ずつ上昇し、これはジ国のGDPの伸びとほぼ同じでZESAの88年のシステム開発時の予測3.3%に近いものであった。ZESAは、93～95年度における販売電力量は、早魁による需要落ち込みと供給不足で抑制され、96年初期ではジンバブエが隣のモザンビークと南アフリカとともに設置する高圧電線の少なくとも1系統が完成し、供給不足が軽減されるだろうとしている。その間経済成長は早魁からの復旧により、93年に回復し、90年代半ばからは構造調整計画の実施により、平均5%を越えるだろうとしている。

歴史的に電力需要のGDPに対する弾性値は1.08であり、これは電力需要の成長が5%の範囲であることを示唆している。

ZESAが93～95年の間に商業的経済的価格を導入すれば、料金は増加し、このことにより、電力の非経済的消費が減少し、需要の成長を抑制することが期待されるとしている。それゆえ、電力需要は96年以降、年平均4%の率でGDPよりも低い率で上昇する見通しとなっている。

8. 協議結果

a) National Economic Planning Commission/Ministry of Finance

表敬を兼ねて、対外的な援助・協力の窓口である両省庁を訪問し、今回の調査団の来訪目的及びJICAの技術協力・開発調査のスキームを説明した。Ministry of FinanceのMR.Matshalagaは昨年JICAに高級研修に来た経験もあり、JICAの援助スキームを熟知していることもあり、今回の開発調査の調査団に熱い期待を表明した。

b) UNDP (United Nations Development Programme/Headquarters·Harare)

UNDPから聴取したプロジェクトの概要は以下の通りである。

負担700万US\$, ジ国負担200万Z\$により、95年12月までに9000台のシステム設置を目標とするものである。これまで、約1000軒の家庭に45Wの分散型太陽光発電システムを設置している。このプロジェクトは、Agriculture Finance Corpor

ation に、Revolving Fundを設置し、需要者が太陽光発電システムを最高36ヶ月の分割方式での購入を可能とするとともに、民間の製造・据えつけ業者に対する技術支援を行うことにより、品質向上とコストダウンをはかることを目標にするものであるとの説明を受けた。

c) PMU(Project Management Unit)

JICAの開発調査の手順・方法などの説明を行う。また、その際にはUNDPとの調査領域・内容の重複を避ける意向を表明した。これに対し、PMU側は以下の2点に関し主な関心を示した。

・ JICAプロジェクトの開始時期

「ジ」側からの要請書の提出があり次第、プロジェクトの開始検討を行うが、予備調査／本格調査の開始ははやくても来年の6～7月以降になる見込みであることを説明した。更に、本調査団より、UNDPが現在実施中のプロジェクトの現地調査を申し入れたところ、現在小集落の地方電化を試験的に行っているハラレ北部のMt. - Darwinを推薦され、20日に現地調査を行うことと決定した。

d) ZESA(Zimbabwe Electricity Supply Autholity) との協議

ZESA側に今回の調査団派遣に関する経緯などを説明したところ、ZESA側は現在の方針として、「全国配電網整備計画のみ関心があり、太陽光発電プロジェクトについては、監督官庁である運輸・エネルギー省の電気局がこれを所轄することとなる。」との解答を得た。よって、今後の協議の相手をDOEにしぼって行うこととした。

e) SEIAZ(Solar Energy Industry Association of Zimbabwe) との協議

協議の要旨は以下の通り

・ AFCは「ジ」国内に26のブランチオフィスがあり、きめ細かなアフターケアを試みている。ユーザーよりローンの申し込みがあると、審査・据えつけの決定を経て、融資を実行している。

・ システムの保証期間は2年。

・ UNDPのGEFプロジェクトでは、24社が据えつけの会社として認定を受けている。

・ また、コントローラー製造は1社(Solartec)、ライト製造は2社認定されている。モジュール製造は1社(Solarcomm)が認定されている。

・ 現在のGEFプロジェクトでは、すべてのモジュールを輸入にたよっており(SEAMENS、京セラなど)、輸入モジュールを組み立てるのみとなっている。

・ Solartecの現在の生産量は月産400台程度で日に20個程度を目標としている。

・ また、UNDPでは45Wレベルのシステムに需要が集中しているが、太陽光発電を必要とする人々の大部分は1日に3～4時間程度の使用時間と考えられ、1家庭2部屋、2ライト・1ラジオを想定した20Wシステムの開発を進める予定である。

・ 現在使用している12Vの自動車用バッテリーは適正に使用されるかぎり問題はないと考えられる

・ 12Vバッテリーは2年程度の信頼性しかないため、今後はユーザーのアフターケア、ユーザーに対する教育を考えていく必要がある。

・ 現在のメンテナンスフリーバッテリーは価格面で対象となるユーザーには高すぎる。

・ バッテリーの値段

大：400～500Z\$, 小：200Z\$程度。

・ PVシステム一式は現在4000Z\$程度であり、水準が高すぎる。

f) 太陽光地方電化現地調査

UNDPのプロジェクトサイトを見学した。(別添地図参照)

プロジェクトサイトはハラレ市の北方約車両で約200km/3時間のMt. Darwinの奥にある約28戸程度の農村集落である。集落は配電線より十数km離れており配電線は届いていないが、集落近くの学校まで電話線は届いている。とうもろこし、豆などの栽培の他、タバコなどの換金作物を主な収入源としており、比較的生活の安定した集落であることが感じられる。現在、28戸のうち11戸が太陽光発電システムの恩恵に浴しており、その主な用途は電灯・ラジオ・テレビなどである。現地調査では、2戸の家庭を訪問しその利用状況を調査した。

調査例1)

10人家族であり、とうもろこし・タバコを主な収入源とする。電化前はケロシン油による生活をしていた。システムの購入価格は6000Z\$であり、頭金として1500\$支払い、残金を作物収穫後に2回に分けて支払うローンを組んでいる。システムは45Wシステムであり、5部屋それぞれに9Wの電灯を備えつけている。システムのインストール、コントローラともにジ国内の業者が行っており、2年に6回の定期点検が行われている。94年4月購入後、現在までに特に不具合の発生は無く、システムの有効活用が行われている。

調査例2)

8人家族で、とうもろこし、タバコなどの換金作物などにより年収は30000ドルを数え、「ジ」国平均の約2倍の収入があり、富裕な農家に数えられる。システム購入は4月で45W/7000Z\$のシステムで用途は電灯(6か所)、テレビ、ラジオなどである。この調査例も1)に同じく、特に不具合の発生は無く、システムの有効活用が行われている。

以上が現地調査の概要であるが、ジンバブエ国の識字率が60数%と他のアフリカ諸国に比較して格段に高く、初等教育の就学率が100%を越えていることなどより、家庭電化に潜在的なニーズが非常に高く、地方在住の0.2%しか配電網による電化の恩恵に浴していないことと考えあわせると、太陽光による電化は非常に有効な手段であることが推測される。しかし今回の対象地域はジ国中でも比較的富裕な地域を対象に行われており、地方在住者の中にはシステムを自力購入できない程貧しい人も多く、今後このような人びとに対してより利用しやすい安価なシステムを考えられるかどうか重要な鍵となる。

g) DOE (Department of Electricity) との協議

ZESAとの協議で、太陽光発電地方電化計画に関する主轄がジ国の運輸・エネルギー省であるとの指摘をもとに、そのなかの主轄部門である電気局との協議を行った。

協議は都合3度行われ、

- i) 今回の調査団の来訪目的説明、開発調査の業務概要説明、協力(案)提示
- ii) JICA協力(案)に対する質疑応答、協力改定案の提示
- iii) ジ国側からの要請書(案)提示

以上のような流れのなかで、ジ国側よりUNDPのGEFプロジェクトとの重複の問題が疑義として出されたり、また、ジ国の民間企業・コンサルタントへの支援の可能性につ

いてなどの質問がでたが、JICAの技術協力の基本原則からは二国間での官ベースでの範囲に限定される旨など説明しつつジ国における太陽光発電地方電化に関するJICAのプロジェクト案概要について説明を重ねた結果、23日、帰国前日の3回目協議にてジ国側から要請書の提出があるに及んでDOEとの協議を終えた。(別添資料2)

今回ジ側と合意に至った要請書のドラフトは別添の通りである、ジ側は大蔵省及び、National Planning Commissionとの協議を経て右要請書を外交チャネルを通じ、日本側に提出する旨調査団に確約した。

(了)

ABBREVIATIONS AND ACRONYMS

CIDA	Canadian International Development Agency
DANIDA	Danish International Development Agency
DOE	Department of Energy
EAG	Executive Advisory Group
GEF	Global Environment Facility
GTZ	Gesellschaft fuer Technische Zusammenarbeit
kWh	Kilowatt-hour
MOT	Ministry of Transport
mW	Megawatt
NGO	Nongovernmental Organization
NPM	National Project/Programme Manager
NRSE	New and Renewable Sources of Energy
PMU	Programme Management Unit
PTC	Post, Telegraph and Communications
PV	Photovoltaics
SADCC	Southern Africa Development Coordinating Conference
SCOTFIN	Scotfin Ltd.
SIA	Solar Industries Association
UNDES	United Nations Department for Economic and Social Development
ZESA	Zimbabwe Electricity Supply Authority
ZIMBANK	Zimbabwe Banking Corporation Ltd.

UNITED NATIONS DEVELOPMENT PROGRAMME

GLOBAL ENVIRONMENT FACILITY

Project of the Government of Zimbabwe

Title: Photovoltaics for Household and Community Use
Number: ZIM/92/G31/A/1G/01
Duration: Five years
Project Site: Zimbabwe
UNDP Sector: Energy
Subsector: New and Renewable Sources of Energy
**Government
Implementing Agency:** Ministry of Transport (MOT): Department of Energy (DOE)
Executing Agency: United Nations Department for Economic and Social
Development (UNDESD)
**Estimated Starting
Date:** September 1992
Government Inputs: Zim \$2 million (US \$382,650)
UNDP/GEF Inputs: US \$7 million

Brief Description:

This programme is intended to strike a balance between development and environmental concerns by using a sustainable model of solar electricity dissemination in Zimbabwe's rural areas to address the issue of global warming and greenhouse gas (GHG) emissions.

The programme will enable the country to:

- Reduce the need for conventional electrical grid extension while immediately displacing carbon emissions from kerosene and candles

- Enhance and upgrade its indigenous solar manufacturing and delivery infrastructure through technical assistance, technician training, and provision of critical inputs to alleviate constraints on manufacturing
- Develop an expanded commercial market in rural areas for affordable domestic solar electric lighting systems by providing low-interest financing through existing institutions to allow householders to purchase home solar systems
- Establish new credit mechanisms at the grassroots level that will benefit lower income groups in rural areas.

A. CONTEXT

1. Description of subsector

Energy consumption in Zimbabwe is six times the average for Sub-Saharan countries. The Zimbabwe Electricity Supply Authority (ZESA), a parastatal company formed in 1986, is responsible for supplying and managing the country's electrical system.

Installed electrical capacity is currently 1,961 megawatts (mW). Of this, 50 percent is derived from coal-powered thermal stations at Hwange, 16 percent from old thermal stations and 34 percent from the Kariba hydropower station. As much as 30 percent of total supply is imported from Zambia's share of the Kariba power generating system.

Eighty-four percent of Zimbabwe's electricity is consumed by industrial and commercial customers in the manufacturing and mining sectors. The remaining 16 percent is used by residential consumers, virtually all of whom live in urban areas or on commercial farms. Transmission and distribution line losses are approximately 9 percent, a relatively low figure on a continent where such losses may run to 60 and even 80 percent.

At present, approximately 20 percent of Zimbabwe's households have access to electricity, and only 16 percent of rural growth centres have grid electricity. With an average rural population density of just nineteen inhabitants per square kilometer, rural electrification is extremely expensive and energy consumptive. The rural population living in areas served by electricity is approximately 155,000, less than 3 percent of the district council/resettlement population of 5.2 million. Approximately 6 percent of households in electrified centres are actually connected, indicating that the proportion of the district council/resettlement population benefiting from electricity is only about 0.2 percent.

In 1984, the government launched a programme of rural electrification to improve the standard of living in rural areas and to increase the rate of economic growth and employment generation. Between 1984 and 1988, the government spent approximately \$10 million on rural electrification before putting the programme on hold due to a lack of funds. (Note: all figures are in U.S. dollars. Zim dollar (Z\$) conversions are provided where necessary.)

Rural electrification is aimed at providing electricity to selected rural growth centres through extension of the national electrical grid. Seventy-two such centres were targeted but by 1987, only half of these had been connected. Moreover, arrival of the grid has not made electricity more accessible to the vast majority of rural households in these areas. By mid-1987, an average of only ten households per centre were connected to the grid at an estimated cost (including distribution, line extension and hookup) of \$6,000 per household.

Demand for electricity will soon exceed ZESA's capacity; by the year 2000, demand is expected to reach 2,362 mW.

2. Host country strategy

"Growth with equity" is the official development strategy of the government of Zimbabwe. With over 75 percent of the country's population living in rural areas, the government focuses a proportional amount of attention on the delivery of basic services to rural people. Electricity is seen by the government as a critical component of rural development.

The government regards rural electrification as a way to slow rural-urban migration, reduce fertility, increase literacy and improve the overall life of the nearly 8 million people who live in rural areas, virtually all of whom are without access to grid-supplied electricity.

Electrification of households, small businesses and community service facilities is a prime national objective and one of the most pressing challenges facing the government today. With the publication by the Ministry of Transport (MOT) of the Electrification Master Plan in December 1991, the government is focusing its attention on the problem of electricity for rural Zimbabweans.

3. Prior or ongoing assistance

The World Bank is negotiating the final component of an overall \$30 million loan for rehabilitation of the existing transmission and distribution system. This loan did not, nor will it in the future, aid grid extension.

The Canadian International Development Agency (CIDA) has an industrial energy conservation project in Zimbabwe operated through the Southern Africa Development Coordination Conference's (SADCC) Harare office.

Deutsche Gesellschaft fuer Technische Zusammenarbeit (GTZ) is providing assistance and follow-up of the rural electrification masterplan study. GTZ has assisted the Department of Energy to establish a database on photovoltaic (PV) installations in Zimbabwe, which will be an invaluable aid to the GEF PV programme.

4. Institutional framework for subsector

ZESA manages Zimbabwe's electrical generating facilities and distribution systems, along with the country's rural electrification programme. ZESA is one of the best managed utilities in Africa.

MOT sets operational guidelines for ZESA and overall energy policies for the country. MOT's Department of Energy (DOE) works closely with ZESA on planning and development.

The DOE has four departments, including Research and Development, to which solar activities are attached. The department's total annual research and development budget is less than \$25,000. The GTZ assists the department with a project called Energy Programme Zimbabwe, for which it has seconded two GTZ personnel. The Energy Programme Zimbabwe has contracted a Zimbabwean consulting firm to assist in a study on the dissemination of PV in the rural areas of Zimbabwe.

The DOE has officially endorsed the use of PV to provide access to electricity in isolated rural areas, noting in a project proposal (Enhanced Solar Photovoltaics Development in Zimbabwe) that the demand for PV systems in the country is very large. This DOE PV project proposal advocates setting up local quality control and evaluation standards and verification systems, including local PV component standards and testing, as well as the proper rural credit facilities to guarantee the ability of the rural end-user to buy the equipment.

Government agencies actively engaged in rural development include the:

- Ministry of Lands, Agriculture and Rural Resettlements through AGRITEX; the Agricultural Development Authority (ADA), and the Agriculture Finance Corporation. These institutions deal directly with the majority of Zimbabwe's population living on small family farms in the rural areas and on communal lands.
- Ministry of Community and Cooperative Development, which has extension offices in all eight provinces, and provides advisory and auditing services to local cooperatives and credit institutions.
- Ministry of Local Government, which interacts with people at the grassroots level through the district councils.
- Small Enterprise Development Corporation, which makes grants and loans to small businesses and entrepreneurs.

Numerous private nongovernmental organizations (NGOs) are interested in rural energy development, appropriate technology and energy planning. These include Environmental Development Action in the Third World (ENDA), Zimbabwe Energy Research Organization (ZERO), Silveira House, the Southern Centre for Energy Development, Africa 2000, World Vision, the Biomass Users' Network, the Solar Energy Society of Zimbabwe and the Solar Industries Association (SIA) of Zimbabwe.

B. PROJECT JUSTIFICATION

1. Problem to be addressed and the present situation

About seventy percent of the people in developing countries have no access to electricity. As this demand is met and continues to increase through population growth and economic development, GHG emissions will also increase. According to current projections, the greatest growth in GHG emissions over the next thirty years will occur in developing countries.

Increased energy efficiency can result in immediate energy savings and offset the need for future capacity in the same market. But this would only address a small part of the real problem, which is the future demand for basic electrical service by the vast unelectrified majority in these countries, and the ways in which that demand can eventually be satisfied in a sustainable, environmentally acceptable manner.

Meeting the combined demands of energy conservation, environmental preservation and economic development is an especially significant challenge for Zimbabwe. Despite having one of the largest power systems in Sub-Saharan Africa, Zimbabwe has not been able to meet the energy needs of the great majority of its people.

Looking toward the future, Zimbabwe has several alternative sources for generating additional power. Exploiting two of these - the potential for hydropower and the vast reserves of coal (estimated at 30 billion tons with proven exploitable reserves of 2 billion tons) - can have serious environmental consequences. Should Zimbabwe choose to increase its coal utilization at power plants such as Hwange I and II in order to satisfy the need for rural household electrification, it would do irreversible damage to its own environment while contributing to global warming. For this reason, Zimbabwe's coal and hydropower resources should be conserved for industrial needs and used to provide economic growth in urban and semi-urban areas.

A third source of available energy - solar power - can enable Zimbabwe to reduce its reliance on coal, avert atmospheric and other forms of environmental degradation that would result from conventional power sources, and still provide electricity for the majority of its population. With an average of 3,000 hours of sunshine per year falling at the rate of up to 2,200 kilowatt-hours (kWh) per square meter, Zimbabwe's solar radiation is 20 to 25 percent higher than in East or West Africa, and is surpassed only by Arabia and the American Southwest.

Current extent of PV use in Zimbabwe

At least 3,000 PV systems have been installed in rural and semi-urban homes, rural health clinics, rural stores, beer parlours and entertainment centres, in schools and for telecommunications purposes. About one-third of home solar systems are purchased by urban area workers for their rural relatives or families. Many others are purchased by rural civil servants with regular incomes.

Of an installed capacity of 151 kilowatt-peak analyzed to date by the DOE, 41.8 percent is used for lighting, not counting PV used by Post, Telegraph and Communications (PTC), the National

Railways of Zimbabwe and the Zimbabwe National Army. Domestic home lighting constitutes over 23 percent of the PV market.

Currently, there is only one Zimbabwean solar module and systems manufacturing company, Solarcomm, along with smaller firms specializing in the production and installation of home and community solar electric systems. Most installations in the country are in Mashonaland and Manicaland, with only 15 percent of the systems installed in Matabeleland.

Local production capacity, using solar cells imported from Japan, is approximately 150 kW per year, although actual production is only about 80kW. Institutional PV applications are largely the result of donor projects using local design firms to install imported solar panels and components. Imports are otherwise restricted by the commodity import licensing system, foreign exchange allocations, and high duties on finished modules.

A considerable number of solar home systems are purchased with cash or credit arranged by solar dealers or through Scotfin Ltd. (SCOTFIN), the financing arm of the Zimbabwe Banking Corporation Ltd. (ZIMBANK). A huge demand has been identified by these companies, but satisfying it is constrained by insufficient foreign exchange allocations, and a lack of affordable and convenient end-user financing. As of this writing, SCOTFIN was no longer making solar loans because of high interest rates, a shortage of funds, and a reluctance to carry hundreds of additional small loans.

Forty-one percent of the cost of PV in Zimbabwe results from government taxes, tariffs and duties. As a result, Zimbabwe's solar PV systems carry the highest price tags on the continent. Evidence suggests that the market would expand, and this technology would be considerably more affordable for the average rural family, if the government were to waive these duties in the interests of social and rural energy development as has already been done in Botswana, the Dominican Republic, Kenya, Namibia and Tanzania.

Official views on the importance of PV

SADCC has recognized solar PV as "one of the most promising technologies" available in the sunshine-abundant Southern African region. However, SADCC's Energy Sector has also noted that rural energy needs are not always regarded as an integral part of the rural development process. As a result, there are often constraints to expanding the utilization of solar PV and other new and renewable sources of energy. These include:

- Lack of locally produced components and raw materials
- Lack of private sector capacity in manufacturing, distribution, installation and maintenance
- Lack of data for the design of PV systems
- Limited availability of foreign exchange
- Cost of PV
- Inadequate financing programmes
- Lack of trained manpower
- Lack of public awareness of the technology

- Lack of institutional framework to ensure quality and sustainability of new and renewable sources of energy (NRSE)
- Inappropriate import duties and sales taxes
- Lack of clear government policy.

In its recent "Study on NRSE Pricing in the SADCC Region," SADCC recommended eliminating or reducing surcharge and import duties to no more than 10 percent of the cost of PV components and products, eliminating sales taxes for NRSE technologies, eliminating foreign exchange controls, and establishing a set of installation standards determined by national energy ministries. In another recommendation, the Harare Declaration has called for "long-term loans for renewable energy investments that include the accounting of the saved costs for conventional energies into the amortization rate of renewable energy investment."

Zimbabwe's long-standing interest in solar energy was expressed by the Permanent Secretary for MOT/DOE in Harare in November 1991, while chairing a three-day International Solar Energy Conference on Economic and Political Initiatives for Application of Renewable Energies in Developing Countries. At that session, the Permanent Secretary called for a "solar light revolution to bring civilization to the many dark corners of Zimbabwe." Photovoltaics, he added, "can provide this light and fill the gap between no electricity and the national electric grid." He predicted that by the year 2020, every household in rural Zimbabwe could be illuminated with solar electricity.

A DOE-sponsored national PV workshop identified numerous advantages of PV systems relative to present services. Among these were the better quality of light; continuous service; convenience; lack of smoke, fumes and danger of burning; and the reduction of urban-rural disparities.

In October 1991 Zimbabwe's PV manufacturers, design and installation firms, and other interested parties gathered for a one-day workshop sponsored by the DOE. The workshop advocated the formation of a Zimbabwe Solar Industries Association, which has now been established, and which will play a key role in this project. Noting that PV is a viable option to bring about decentralized rural electrification with the kind of power requirements most commonly needed by small-scale rural users like homes and shops, the workshop recommended that:

- PV equipment should be put on the Open General Import License and special consideration should be given to the reduction of duties, tariffs and taxes
- Local technology and systems components should be improved to provide greater reliability
- Zimbabwe's PV business should be more decentralized to provide better marketing and service
- Credit facilities must be provided, preferably through existing institutions with collateral guarantees from a supporting agency.

This was the situation regarding PV in Zimbabwe at the time of the UNDP/GEF Mission in November-December 1991.

2. Expected end-of-project situation

By the completion of this five-year project, a number of significant advances should have been made:

- As many as 25,000 rural homes should have been directly illuminated. An equal number of PV systems should also have been indirectly sold as a result of the programme. (Experience gained in the Dominican Republic, Kenya and Sri Lanka indicates that two cash customers come forward for every person buying on credit when both financing services and technology are introduced in a rural area.)

Available funds from the programme are sufficient to install up to 9,000 home solar systems of 45 watts (W) each at current prices. As the revolving fund is replenished by consumer down payments of \$100 plus installment fees, the fund will provide for an additional 5-6,000 systems over the project period, depending on the inflation rate and currency stability. Furthermore, should half of the 9,000 initial systems be no larger than 20 W (including battery-charging operations), another 5,000 or more households could receive electric light and power for radios under the programme.

- A sufficiently large number of households and community institutions will have received solar electric systems through this pilot programme. This will allow for a valid assessment and demonstration of the technology and the various approaches to its promotion and dissemination.
- Capacity-building through the existing solar manufacturing industry, commercial financial institutions, government ministries and agencies, district councils, NGOs and ZESA will demonstrate that solar PV can play a key role in Zimbabwe's energy future while enhancing economic development. The resulting expanded use of solar PV will be a model for sustainable rural energy development throughout the region and the world.
- This appropriately scaled renewable energy technology will demonstrate that it can effectively meet most rural household needs for electricity in a way that does not harm the environment.
- Operating under an Economic Structural Adjustment Programme, liberalized trade laws, a market economy, and available credit through ongoing revolving credit funds, the commercial solar industry should be able to offer home solar systems to rural people at affordable rates.
- Prices should drop as a result of open competition and an expanded market. Prior to the recent Zim dollar devaluation, costs were approximately \$600 for a 45 W system including four 20 W fluorescent lights, wiring switches and installation.

- A positive climate should be achieved for financial investment in projects and institutions that are attractive to the World Bank and to commercial investors. The Zimbabwe-based solar industry should be able not only to serve its local market, but export through the countries in the SADCC region.
- Funds remaining in Zim dollars in the revolving fund at the end of the programme will be allocated by the DOE to an institution involved in further dissemination of solar home systems. Any recurrent costs attributable to the programme after its termination may be covered by remaining funds at the discretion of the DOE.

3. Target beneficiaries

The target beneficiaries will be people living in unelectrified rural areas, especially those who, with the assistance of concessional financing mechanisms, can afford to purchase their own 20 to 50 W solar electric lighting systems. As already noted, 0.2 percent of the 5.2 million people living in communal and resettlement areas are connected to grid power. Another 155,000 people have access to the grid power supply, but remain unconnected.

The programme will also attempt to target the "true" rural poor - the 80 percent without PV purchasing power - by helping to develop and produce very small 5, 10 and 15 W lighting systems along with affordable hire purchase financing. These very small systems, over 500 of which have already been sold in Zimbabwe, provide the proverbial "light over the kitchen table" allowing children to study, the family to gather, a radio to be played.

Income levels will be one criterion for targeting markets and market areas. In addition, beneficiaries should live at least 5 kilometers beyond the nearest main power line. Employment rates, commercial farming activities and the existence of NGO- or government-sponsored community development activities may also help determine criteria. The commercial marketplace will self-select scattered beneficiaries throughout the country.

Since several hundred thousand people live in semi-urban areas where power is available but where ZESA has not been able to afford household hookups, one or two such peripheral urban residential areas will be targeted as a proof-of-concept alternative to grid hookup. Homes that are clustered in communal areas near district and rural service centres will be ideal targets. At least three communities of 100 to 500 houses each will be identified, and the goal will be to electrify virtually every house.

Decisions regarding geographic target areas will be left to the Provincial Development Councils, the Programme Management Unit (PMU) and the Executive Advisory Group (EAG). A vigorous awareness campaign will be undertaken so that all eight provinces may receive a share of the PV systems.

Ten percent of the available development funds will be allocated for community use, including clinics, hospitals, schools and community centres. By allowing the technology to be demonstrated and observed, schools and clinics are often catalysts for further solar development in a given area.

Traditionally, such institutions have been the beneficiaries of donor aid projects which provide complete solar systems gratis. This project, however, will require each community institution to pay for service, thus permitting them the same access to the revolving fund at the same concessional rates as individual consumers. These systems will cost a great deal more than a typical home solar system, and funds will be loaned to qualified community associations accordingly.

Costs and ability to pay

The fee for being connected to the electrical grid is \$125 plus ongoing monthly bills of \$10 to \$15. This is more than many people can afford. In addition, because most grid-connected rural families have very low consumption rates - less than one kWh per day - the cost of being hooked up to the grid cannot be justified.

By contrast, a 45 W photovoltaic system, purchased with a \$100 down payment and paid for over thirty-six months at \$15 per month, will provide sufficient power for twenty years with only minor maintenance and occasional battery replacement.

A 1991 DOE PV workshop analyzed three sizes of domestic lighting systems - 20, 50, and 100 Watt-peak (Wp) - and their costs to the consumer compared to their present energy expenditures for kerosene, dry cells, candles and car batteries (carried to and from garages for charging). The study found that 70,000 households would be ready cash customers for 50 Wp systems. Twenty percent of the population of rural areas was found to have sufficient purchasing power to acquire home solar systems through hire purchase.

The study recommended that the remainder of the rural population without sufficient purchasing power - nearly 80 percent - be serviced through solar-powered battery charging stations. These stations could use six 45 Wp panels to charge fifty small deep-discharge solar batteries. These batteries would be leased to clusters of fifty families; every ten or fifteen days the batteries would be returned for recharge or exchange, with a cost per family of \$2 to \$3 per month. The batteries for this programme would be manufactured in Zimbabwe.

The Electrification Master Plan identified a clear ability-to-pay and a willingness-to-pay for electricity (either grid extension or PV). The document points out that non-electrified households average higher monthly energy bills than electrified households. Batteries for powering radios and televisions (both dry cell and automotive) account for an average of 48 percent of monthly energy expenditures, while candles and paraffin account for 30 percent. Excluding firewood costs, non-electrified families pay more for energy than do ZESA's customers. The average lighting cost for a non-electrified family living in a rural centre is \$16 per month.

In addition to consumer savings, considerable foreign exchange will be saved as the one-time outlay for imported PV equipment is much less than the cost of a family's twenty-year supply of imported kerosene.

No funds will be made available through the programme for mini-grid or micro-grid systems. Numerous United Nations and World Bank studies have concluded that PV village electrification is

more viable using individual (stand-alone) unconnected PV systems than a mini-grid powered by a single large PV system or mini-utility.

4. Project strategy and institutional arrangements

In order to achieve results in the most cost-effective manner, this programme will utilize Zimbabwe's existing commercial sector delivery infrastructure. As the Secretary for Energy has stated, "It will be the private commercial sector who will be instrumental in delivering photovoltaics to the people." This is government policy as well as the intention of this project.

The project will utilize its equipment procurement capacity to maximum advantage to provide the necessary imported hardware, components and commodities required for the production of solar electric systems. Equipment delivered to the project will be made available to ZIMBANK or other such entity as the government designates. This entity, in turn, will arrange for its transfer to manufacturers and suppliers on payment of the landed costs to a revolving fund maintained by ZIMBANK in Zim dollars. The revolving fund will be administered entirely by ZIMBANK and will be used to extend consumer credit through ZIMBANK and its financing arm, SCOTFIN, for end-user purchases of the home solar and community PV systems.

Severe foreign exchange restrictions have inhibited the local solar industry, which has not been able to meet demand because 60 to 70 percent of its product is imported. Import license restrictions are a second inhibitor. To avoid this, critical inputs will be made available to local suppliers; simultaneously, local funds will be provided to credit institutions to on-lend to consumers.

The executing agency will take responsibility for procurement of equipment through a flexible arrangement with established local companies. The national project director will consult with the local companies in determining equipment specifications and will forward these to the United Nations Department for Economic and Social Development (UNDESD) for procurement action. The local module manufacturers, suppliers and installers will receive their allocation through the PMU.

ZIMBANK will manage the account directly from its main office in Harare. ZIMBANK was selected because the majority of its shares are owned by the government and it has considerable experience in lending in the domestic solar market.

SCOTFIN and the bank's branch offices will manage three basic financing schemes:

- Dealer financing for aggregate loans through block discounts involving 50 to 100 consumers handled by PV suppliers/installers
- Individual consumer financing for solar systems using the solar panel as collateral
- Loans to institutions (such as schools, churches and clinics) and community associations (grassroots revolving credit funds) backed by a loan guarantee from the programme fund.

ZIMBANK will cover its costs through a management fee, and SCOTFIN will be compensated through the interest charged to consumers at a rate to be decided by the project management in consultation with the EAG. (Commercial interest rates currently range from 28 to 40 percent, rendering the consumer finance market inactive.)

Quality, capacity, availability and further criteria set by the EAG and SIA will determine how procurement will be divided between:

- Balance of systems components such as batteries, charge regulators, wiring and switches
- Solar cells, aluminum, low iron glass and tedlar plastic sheet for manufacturing
- Finished modules and complete systems for independent suppliers.

Project equipment will be procured by UNDES and will be exempted from import tax, surtax, and duty, since the project is donor-funded.

Similarly, the National Project Manager (NPM) will seek to negotiate a reduction or elimination of selective import duties, surcharges and sales taxes on all solar hardware. This is the policy of the Ministry of Transport, which has stated: "Given the essential role that PV can play in the social and economic development of rural areas, and in the interest of equity, every effort should be made to reduce the restriction that tax and duty place on the access lower income rural people have to this technology." As mentioned before, duties, surcharges (a blanket 20 percent for all imports) and sales taxes currently represent 41 percent of the cost of a solar electric system in Zimbabwe.

A second direct recipient will be ZESA, which will have allocated to it up to Z \$3 million (US \$573,970) in equipment to put in place through its own programme as many as 1,000 systems of 45 W each in target areas lying just beyond its grid. In this regard, ZESA will cooperate with the executing agency, with funds provided directly from the ZIMBANK Zim dollar revolving fund. Solar electric systems will be provided to ZESA by the private sector and either installed by them, or by ZESA's trained technicians. ZESA will be allocated its share of the programme based on an acceptable plan submitted to the PMU, with the planning process funded by a small grant from the programme.

ZESA will decide whether to lease or sell systems to its customers. ZESA has the advantage of being able to amortize the cost of household systems over ten or twenty years, thereby requiring only a small monthly payment by householders to its district offices, either directly or through the PTC Bank.

A third group of recipients may be district councils, local solar energy credit associations, the Agriculture Finance Corporation, or NGOs. These will access the Zim dollar account pursuant to approval of marketing plans by the PMU and NPM. One or more subcontractors will engage in managing the programme's "third approach" of community development as mandated in the project brief. An amount to be agreed upon by the EAG will also be reserved for this approach, in addition to the provision of community development assistance from the PMU and consultants.

The SIA will recommend which companies qualify to participate in the programme by virtue of product and installation standards, marketing ethics and performance. The EAG will review and endorse the association's recommendations.

To meet the goals of the programme, the participation of most of the existing companies and perhaps a few new ones will be required. In addition to the sector's regular business, between fifteen and twenty installations a day, for at least 200 days a year, will be necessary during the three-year implementation phase.

The commercial manufacturing sector will have access to equipment worth approximately \$4.8 million, and end-users serviced by the private sector will have access to as much as Z \$22 million (US \$4,209,100) at current rates of exchange (after subtracting the Z \$3 million (US \$573,970) set aside for ZESA).

Implementation arrangements for the programme include setting up under the implementing agency (MOT), at arms-length, a separate programme management unit, the PMU, as mentioned above. The unit will have an office in central Harare with separate phones. The-programme funds will provide furniture, phones, transport and fuel, and computers to the PMU.

Attached to this unit will be the UNDESSED's NPM, a national to be recruited locally, with the approval of the MOT, and paid in Zim dollars by the executing agency. The NPM is responsible and accountable to the UNDESSED for the overall programme, including financial, administrative and technical activities. The NPM will cooperate closely with the MOT and DOE. The NPM's counterpart at the DOE will be the Director of Energy.

Also attached to the PMU will be a full-time national project officer hired by the executing agency and paid in Zim dollars. A secretary and drivers will be hired by the NPM and paid in local currency. A vehicle will be provided to the NPM along with several vehicles provided to the unit for the primary purpose of visiting rural areas. One vehicle from this allocation will be provided directly to the DOE and kept at its premises for visits to rural areas to monitor the project.

Seconded to the unit will be several staff researchers, analysts and programme officers from the DOE, as the ministry's in-kind contribution to the programme. An important role of the DOE personnel will be the monitoring of the programme through periodic site visits, and the enforcement of standards. They will receive per diem and expenses from the programme for travel on behalf of the PMU. Several vehicles will be provided to the PMU and DOE for official use (as grants to the government).

The PMU will also include a national expert who will be responsible for day-to-day programme management, especially outreach activities in the field. The purpose of this national outreach expert will be to provide expertise in PV and rural energy development to the programme. He will report to the NPM, and will have an annual contract, renewable for a maximum of four years. Either an individual or an organization may be subcontracted. Other short-term national consultants are provided for in the budget for particular services apart from programme management.

There will also be one international expert in PV engineering. This expert, reporting to the NPM and the outreach programme manager, will provide specific technical services, including the organization of a standards programme, technical training, the development of inexpensive small solar lighting systems, socialization and diffusion of solar technology, and the facilitation of community interaction at the village level. The international expert's contract will be for two years only.

Funds will be allocated for several national consultants/task managers or firms to handle other aspects of the programme, including training, public awareness, media liaison, video production, publication of materials, education and community development. United Nations volunteers may also be attached to the PMU to perform specific assigned tasks.

Finally, an EAG (or "operations group" or "steering committee") will be formed to advise and recommend on policy and operations to the PMU. The six-member EAG, which will meet monthly or when required, will include the Director of Energy, the NPM, the outreach expert, and a representative each of SIA, ZESA and ZIMBANK. This group will approve all policy decisions and arbitrate differences of opinion likely to arise in such a joint venture between the public and private sectors.

Numerous other strategies and implementation approaches were considered in great detail by the UNDP/GEF Mission in consultation with the MOT, the DOE and local businessmen. It was recognized by all parties that the ministry and the DOE had experience in the area of renewables and considerable interest in PV applications in rural areas, but that they could not directly manage a programme of this magnitude, nor afford to pay the required management personnel. It was also recognized that this programme would have to be run by Zimbabwe and not by outside agencies, international consulting firms or expatriate managers, although certain international experience would be necessary and welcome. The mission team also agreed that extremely well-qualified, talented and trained personnel existed in Zimbabwe, with enough direct experience in PV and rural energy development to successfully operate the programme throughout its life.

5. Reasons for assistance from UNDP/UNDES

Environmental concerns and the need to address the issues of development and environment together prompted the government of Zimbabwe to request special development assistance under the guidelines of the GEF.

Through the offices of the Ministry of Environment and Tourism, whose Permanent Secretary is a member of the GEF Participants' Committee, a proposal for a PV project for Zimbabwe was tendered to the GEF early in 1991. The GEF Coordinator for Africa proceeded, with the assistance of the Solar Electric Light Fund, and support from the United Nations Department of Technical Cooperation for Development (now the Department of Economic and Social Development), to develop a project brief for GEF consideration. The GEF Implementation Committee approved the project in October for \$7 million.

The project was referred by the Secretary of Environment to the Ministry of Transport for further consideration. The MOT offered enthusiastic support to the project, planned as a five-year programme, with special attention to ongoing infrastructure and sustainability.

Long-standing interest in PV technology within the government and the private sector led to the specific project request. Many senior officials within the government have expressed support for PV energy: ZESA's chairman and general manager have long been members of the Solar Energy Society; the Director of Energy has been involved with renewable energy projects for over a decade; the Secretary of Energy is a member of the United Nations Solar Energy Group for Environment and Development; and the Secretary of Environment has a personal interest in PV.

6. Special considerations

Women

Women will play a key role in the adoption of solar electricity in rural areas as they are likely to benefit most from it. It is usually the women who stay home with the children while their husbands go to work in the city. They also outnumber men by 100 to 70 in rural areas. Confined to dark workspaces and unable to enjoy time with their families after sunset (approximately 6:30 p.m. around the year), they are often the first to show interest in solar lighting. Women's organizations at the national, provincial and district levels may thus become involved in the programme at the request of the PMU.

The environment

The environmental implications of this programme are significant. If, as a result of this programme, 10,000 households begin using solar electricity, the amount of kerosene burned per year per household will decrease by nine gallons. This will annually prevent about 400 tons of carbon from being released into the atmosphere. Also, at a household usage rate of ninety-six environmentally dangerous dry cell batteries per year, these 10,000 households will prevent nearly 5 million dry cells over five years from being disposed of in ditches and garbage dumps. Hydrocarbon emissions from as many as 15 million candles will also be displaced.

A technical review of ZESA's emissions will be conducted during the programme to indicate the degree to which GHGs have been offset by attendant grid displacement.

Economic development

This programme focuses on developing a solar energy delivery infrastructure, including technical training and support for microenterprises. The solar panels and systems required for implementation of the programme may be purchased from the country's only indigenous assembly plant, which will be favoured in the programme, or they may be imported. In either case, an indirect result of the effort will be to rapidly commercialize an already existing small PV industry.

7. Coordination arrangements

Government agencies

Apart from coordination of the programme with ZESA, district councils, NGOs, government agencies and community development associations as described above, it will be advantageous for programme managers to link up with the Ministry of Community and Cooperative Development, which has extension services in all eight provinces.

The Ministry of Information, a strong supporter of solar energy development, may prove helpful in providing educational materials and liaising with government media.

The Ministry of Local Government should be approached to assist with development efforts focused at the district council level.

SADCC

Liaison with SADCC will be important as member states will be watching the programme closely. At a workshop held in Swaziland, Renewable Energy and the Utilities in the SADCC Region, the GEF PV programme was discussed at length, with much interest exhibited by representatives of SADCC utilities and energy ministries.

NGOs

The Danish International Development Agency (DANIDA), GTZ, CIDA and the Swedish International Development Agency (SIDA), have small renewable energy programmes in development stages, and it will be important to keep them informed of the progress of the programme and explore common interests and activities.

DANIDA is engaged in a current project to rehabilitate Solarcomm's manufacturing capacity, and provided new equipment, foreign exchange loans and technical transfer to the company early in 1992.

Other coordination efforts

The programme will sponsor a workshop for NGOs and the donor community in 1992 or 1993 to familiarize Zimbabwe's numerous aid and development organizations with PV technology. It is hoped that they will introduce PV themselves in communities where they already have projects (to be financed through their own resources unless they have qualified as participants in the programme itself, which one or two may do). This workshop may be repeated as a regional exercise in 1994.

Agricultural institutions, shows, fairs and credit bureaux may be asked to play a role in the dissemination of the technology.

8. Counterpart support capacity

The government has offered in-kind support of at least Z \$2 million (US \$382,650) during the life of the programme, as well as to cover any recurrent costs following its termination. This will be largely in the form of salaries to DOE employees seconded to the project, mainly for monitoring efforts, and other local miscellaneous expenses.

9. Possible follow-up

The World Bank may provide additional financing of up to \$15 million in concessional loans or GEF grants in 1994, provided that a successful investment model - either commercial, government-sponsored or parastatal - has been identified within the first two years of the programme.

A video production will be undertaken during the course of the programme to be used as an educational tool around the world to promote global dissemination of solar electrification. Supplemental funding for this project will be sought.

The 1995 World Solar Congress of the International Solar Energy Society will be held in Harare, providing a timely opportunity for Zimbabwe to showcase its GEF programme of solar rural electrification.

C. DEVELOPMENT OBJECTIVE

The development objective of this project is to supply basic electrical service to rural populations lacking access to grid extension. This will be done in an environmentally benign and affordable manner by substituting kerosene and conventionally generated electric power with solar electric power. The programme will serve as a demonstration of an alternative to planned grid extension.

This objective is consistent with the policy analysis made by the Kennedy School of Government at Harvard University for the United Nations Centre for Science and Technology for Development (1990):

Photovoltaics can play an important role in providing electricity to rural areas of Zimbabwe. Under certain conditions of low population density and low electricity demand, PV is a much more cost-effective technology than grid extension... [The] addition of PV to the current electrification strategy could thus provide substantial savings to the government. Further, photovoltaics, if provided to the rural poor at subsidized rates, is financially feasible and will permit users to be owners and managers of their own electricity resources.

The programme will use a proven, innovative and renewable technology to demonstrate new approaches to PV applications. Although PV as a technology has been applied in a variety of settings and under a variety of conditions, the approach which this project describes differs from all existing or previous efforts directed at using PV for rural electrification. It will thus serve to demonstrate an innovative and still unproven technical approach.

D. IMMEDIATE OBJECTIVES, OUTPUTS AND ACTIVITIES

OBJECTIVES

- To facilitate the installation of a minimum of 9,000 domestic solar electric systems in rural areas over three years, as well as small community institutional lighting systems. These systems will be financed through revolving fund mechanisms, which may catalyse sustainable rural energy development.
- To build and develop training, delivery, financial and institutional infrastructures for rural solar electrification that will continue beyond the completion of the project.
- To upgrade local technology and manufacturing capacity while strengthening the local solar industry and commercial sector.
- To create lasting public awareness regarding the appropriate utilization of solar electric technology.
- To employ the three approaches of programme implementation as set forth in the GEF project brief: (1) commercial/private sector; (2) utility; and (3) local community development. Once foreign exchange and consumer credit are available, local suppliers and dealers will begin marketing and installing solar PV systems nationwide.

OUTPUTS AND ACTIVITIES

Output 1

Availability of and immediate access to critical inputs for utilization by Zimbabwe's solar industry to manufacture solar products in accord with market demand and programme needs for the benefit of lower income groups in rural areas.

Activities for Output 1

- 1.1 Establish programme banking and finance procedures through ZIMBANK.
- 1.2 Establish revolving fund in Zim dollars at ZIMBANK to be utilized by programme through ZIMBANK branches and SCOTFIN.
- 1.3 Establish planning criteria, qualifications, and procedures for local industry access to equipment procurement, through the PMU and DOE to UNDES, with initial delivery to a government agency to be designated.

Output 2

Availability of and access to local commercial credit funds for end-users to purchase solar electric lighting systems.

Activities for Output 2

- 2.1 Establish a three-tiered commercial credit system at ZIMBANK/SCOTFIN for dealers, consumers and institutions. Set interest rates for revolving fund and negotiate bank handling fees, if any.
- 2.2 Qualify and inform participating solar electric dealers and installers. Since beneficiaries are the general public, especially lower income groups in rural areas, vendors taking advantage of the scheme should follow basic guidelines established by the PMU and DOE to ensure that benefits are passed on to the public. Project equipment will be exempted from import tax, surtax and duty, being a donor-funded project. The PMU will ensure that resulting cost reductions will accrue to project beneficiaries through a carefully formulated pricing structure.
- 2.3 Identify suggested target areas for commercial introduction and an intensive sales and marketing programme, which will ensure that lower income groups, especially in rural areas, will be the prime beneficiaries. This will be done in association with the NPM, PMU, DOE, and the participating dealers and installers, based on criteria to be established and agreed upon by the above. These criteria might include:
 - Living more than 25 kilometers from Harare or more than 5 kilometers from the electrical grid
 - Income levels
 - Source of income (civil service, farming, business, and so on).

At least one semi-urban high density area of 500 homes should be included since many such areas remain unelectrified despite their proximity to the grid.

- 2.4 Identify interested institutions (such as schools, clinics and community centres) to receive loans for community lighting systems to be installed by commercial dealers.
- 2.5 Provide financing for any household purchasing a PV system that also chooses to install solar hot water as a replacement for wood water heating.

Output 3

Institutional capacity through utility-sponsored dissemination, installation, financing and maintenance of an initial 1000 solar lighting systems of 45 W each as an alternative electrical system.

Activities for Output 3

- 3.1 Provide planning funds and technical expertise to the ZESA rural electrification section so it may begin to plan its project and design its installation and tariff collection programme.

- 3.2 On agreeing upon an implementation plan for installation and maintenance of PV systems in designated target areas, ZIMBANK will release funds of up to Z \$3 million (US \$573,970) over three years. This will enable ZESA to purchase hardware from local private sector suppliers, who will then be able to make corresponding procurements through the project.
- 3.3 Assist ZESA to recruit and train a PV supervisor along with one or two technicians to manage ZESA projects (chief's salary to be paid by local currency revolving fund and recovered through lease or sale of systems to consumers).
- 3.4 Require final report by ZESA regarding successes and failures of projects, and whether PV should be integrated into national energy planning; if so, how. (Responsible parties: NPM, PMU, Director of Energy and ZESA PV supervisor. Systems to be supplied by private sector, and installed by either ZESA personnel or private companies.)

Output 4

A sustainable institutional mechanism for village and district level community development or rural solar electrification, including:

- Rural council-sponsored solar credit association(s)
- Existing or special solar cooperative(s)
- Trained management personnel based in rural areas.

Activities for Output 4

- 4.1 Identify one or several district councils interested in participating in the programme and assist in designing and establishing a locally-based revolving credit system for purchase of domestic and institutional solar lighting. Provide local funds up to Z \$3 million (US \$573,970).
- 4.2 Identify one or several appropriate NGOs to assist in the establishment of local solar energy associations or cooperatives for the purpose of managing local revolving funds and making loans.
- 4.3 Identify specific communal and commercial farming target areas based on criteria developed in association with the NPM, PMU, the Director of Energy and the participating organization(s).
- 4.4 Identify interested community institutions and assist in organizing fund-raising campaigns so they may acquire solar lighting systems with a loan from the central revolving loan fund.
- 4.5 Train local personnel in fund management, PV system maintenance and repair.

- 4.6 Hold competitions among districts for rural PV development. The leading council will win a grant from the programme fund to electrify one school. (Installations by private companies.)

Output 5

Sufficient number of trained and qualified PV technicians and installers.

Activities for Output 5

- 5.1 Assist local companies in enhancing their in-house technician training.
- 5.2 Support the establishment of intensive training courses for qualified applicants.
- 5.3 Establish certification or licensing process for installers and technicians trained through the programme (in association with private sector, DOE and vocational institute).
- 5.4 Arrange for Zimbabwe publication and/or distribution of PV technical handbook *Small Solar Lighting System for Africa* by Mark Hankins.
- 5.5 Support solar industry in setting up branches or independent small-business workshops in rural areas.

Output 6

National public awareness of benefits of solar electricity and how individuals may acquire it.

Activities for Output 6

- 6.1 Prepare a national public awareness campaign for the GEF programme, highlighting its goals, the technology it is promoting and how people can participate. The campaign will use a variety of channels of communication, including television, radio, print advertising, handbills, booklets and appropriate educational materials.
- 6.2 Develop educational materials in association with the Ministries of Education, Community and Cooperative Development, Local Government and Agriculture.
- 6.3 Coordinate the distribution of materials with ZESA, participating community organizations, district councils, NGOs, government agencies and the Ministry of Information.

- 6.4 Hold annual provincial workshops for officials, NGOs, interested public, development workers and students to introduce and demonstrate technology, and report on progress of GEF programme.
- 6.5 Plan for production of video in second or third year of programme. Video to be funded supplementally and released at the 1995 Solar World Congress in Harare.
- 6.6 Hold end-of-programme three-day workshop including all involved parties to analyze and critique experience and draft final report (1996).

Output 7

Improved solar technology including charge controllers, batteries, lights and locally assembled solar PV modules. Development, manufacturing and marketing of small systems (under \$150) that provide electricity for one or two lights and a radio. Development of solar-powered battery charging system for deployment in rural areas. Improved transport capacity.

Activities for Output 7

- 7.1 Technology transfer and technical assistance from international consultant attached to programme (for two years) and other technical experts if required.
- 7.2 Travel to other countries to visit PV companies, as well as government-sponsored rural PV projects in Mexico, Morocco and Senegal, by designated PMU staff and/or Permanent Secretaries for Energy, Environment and Finance, an official from Customs and Excise Department, and several qualified industry engineers and technicians.
- 7.3 Technical cooperation between developing countries in the form of visits by foreign PV experts from countries with similar approaches to rural PV.
- 7.4 International consultant to assist local manufacturers in design, production and marketing of 5 or 10 W lighting system to reach poorest 80 percent of rural market.
- 7.5 Small grants to assist in development of ten solar-powered battery charging units, to be qualified for sale or lease to rural businesses. Approve loan to manufacturer to on-lend to local purchaser or franchisee (approximately \$7,000 per unit to service fifty low-income households).
- 7.6 Make up to \$200,000 vehicle procurements available to qualified applicants. Vehicles to be paid for in equivalent Zim dollars to central revolving fund.

Output 8

Established standards for PV equipment and components, both locally produced and imported, including licensing programme for installers and standards for installation and design. Ongoing testing programme for PV components and systems.

Activities for Output 8

- 8.1 Establish systems qualifications for programme suppliers, and set design and balance-of-systems specifications for two or three systems of sizes agreed upon in consultation with SIA and the Solar Energy Society.
- 8.2 Prepare and establish testing procedures and programme in association with Zimbabwe Standards Association or Zimbabwe Institute of Technical Studies for systems tests.
- 8.3 Send qualified components to European testing facility in Ispra, Italy, to ensure quality hardware for programme.
- 8.4 Establish national standards for PV systems components, modules, installations and training. (This will be a legacy of the programme as it will not be ready at the beginning of the systems installation phase.)
- 8.5 Develop standard required maintenance programme in association with SIA and various dealers as a stipulation to participate in project with access to credit fund.

E. INPUTS

1. Government of Zimbabwe

Department of Energy

Z \$2 million (US \$382,650)
(five years)

Programme Officer
ZESA Project Liaison Officer
Technicians for ZESA (if appropriate) (2)
Drivers and other personnel as necessary (2)
ZESA PV Supervisor (48 work-months (w/m)*)
Office accommodation, including telephones,
fax, telex services

- * Salary and expenses to be paid by project to ZESA pursuant to acceptable implementation plan submitted to PMU. This could be from ZIMBANK, repayable through revolving fund.

2. UNDP

<u>Personnel</u>	<u>w/m</u>	<u>US\$</u>
Project Manager	60	200,000
National Outreach Advisor	48	90,000
Rural PV Specialist	24	220,000
Short-term Consultants (national)	18	90,000
Short-term Consultants (international)	10	150,000
National Project Officer	60	50,000
Secretary	60	30,000
Drivers (2)	120	40,000
Evaluation Missions		45,000
Travel (project personnel)		45,000
Mission Costs (agency)		45,000

Total		1,005,000
 <u>Subcontracts</u>		
Local Subcontracts		20,000
 <u>Training</u>		
Study Tours		60,000
In-country Training (workshops and courses)		90,000

Total		150,000
 <u>Equipment</u>		
Expendable (office supplies)		50,000
Vehicles (for project management)		130,000
Office Equipment		20,000
Test Equipment and Instrumentation		50,000
Vehicles (for installers)		200,000
PV Components and Supplies		4,550,000

Total		5,050,000
 <u>Miscellaneous</u>		
Vehicle Operations and Maintenance		190,000
Sundries		50,000
Report		7,000

Total		247,000
Agency Support Costs		578,000

Grand Total		7,000,000

F. RISKS

Risks associated with this programme include:

- High inflation rapidly eroding value of revolving funds
- Devalued currency increasing end-user cost of PV units
- Lack of effective local participation
- Failure to establish market incentives
- Excessively high import duties that destroy competition
- Surcharges and taxes that increase cost of technology beyond ability of rural people to afford it.

G. PRIOR OBLIGATIONS AND PREREQUISITES

1. **Prior Obligations:** None.

2. **Prerequisites:** The government has indicated its desire to reduce or eliminate import duties, tariffs and surcharges. This will be done over time as part of the Economic Structural Adjustment Programme. Eventually, necessary commodities for the manufacture of solar products will be listed on the Open General Import License. However, these reforms will not take place prior to the implementation of the programme.

H. PROJECT REVIEW, REPORTING AND EVALUATION

The project will be subject to tripartite review (joint review by representatives of the government, executing agency and UNDP) at least once every twelve months. The first such meeting will be held within the first twelve months of the start of full implementation. The programme manager shall prepare and submit to each tripartite review meeting a Project Performance Evaluation Report. Additional reports may be requested, if necessary, during the project.

A project terminal report will be prepared for consideration at the terminal tripartite review meeting. It shall be prepared in draft sufficiently in advance to allow review and technical clearance by the executing agency at least four months prior to the terminal tripartite review.

The project shall be subject to review four months after the start of full implementation. The organization, terms of reference and timing will be decided after consultation between the parties to the project document. There will be evaluation missions at the middle and at the end of the project.

I. LEGAL CONTEXT

This project document shall be the instrument referred to as such in Article 1 of the Initial Standard Basic Assistance Agreement between the Government of Zimbabwe and the UNDP, signed by the parties on 27 May, 1980. The host country implementing agency shall, for the purpose of the Standard Basic Assistance Agreement, refer to the Government Cooperating Agency described in that agreement.

J. BUDGET

A project budget, covering both government and UNDP/GEF inputs, is attached.

PROJECT BUDGET COVERING GOVERNMENT CONTRIBUTION
(in Zim Dollars)

Government Personnel	Z\$ Total m/m	1992	1993	1994	1995	1996	1997
<u>Professional Personnel</u>							
2 Project Officers (Solar)	120	320,000	64,000	64,000	64,000	64,000	48,000
1 Project Officer (Economist)	60	150,000	30,000	30,000	30,000	30,000	22,500
2 Project Technicians (Solar)	120	200,000	40,000	40,000	40,000	40,000	30,000
1 Project Officer (Liaison ZESA)	60	150,000	30,000	30,000	30,000	30,000	22,500
8 Part-time Personnel	30	604,000	120,800	120,800	120,800	120,800	90,600
<u>Administrative Personnel</u>							
1 Driver	60	36,000	7,200	7,200	7,200	7,200	5,400
1 Typist	60	60,000	12,000	12,000	12,000	12,000	9,000
Office Accommodation Telecommunications (Telephone, Fax, Telex)		240,000	48,000	48,000	48,000	36,000	36,000
Total		2,800,000	400,000	400,000	400,000	400,000	300,000

PROJECT BUDGET COVERING UNDP CONTRIBUTION (in U.S. dollars)

PAGE 1

DATE PRINTED: 02/07/92

LAST REV.: 02/07/92

COUNTRY : ZIMBABWE

PROJECT NUMBER : ZIM/92/031/A/IG/01

SHADOW BUDGET

PROJECT : PHOTOVOLTAICS FOR HOUSEHOLD AND COMMUNITY USE IN ZIMBABWE

PROJECT COMPONENT	TOTAL AMT M/M	1992 AMT M/M	1993 AMT M/M	1994 AMT M/M	1995 AMT M/M	1996 AMT M/M	1997 AMT M/M
010 PROJECT PERSONNEL							
11 Experts:	220,000	27,500	110,000	82,500			
011-001 RURAL PV EXPERT	24.0	3.0	12.0	9.0			
011-050 SHORT-TERM CONS.	150,000	45,000	45,000	30,000	15,000	15,000	
11-99 Subtotal	370,000	72,500	155,000	112,500	15,000	15,000	
	34.0	6.0	15.0	11.0	1.0	1.0	
13 Admin. support pers.:							
013-010 SECRETARY	30,000	1,500	6,000	6,000	6,000	6,000	4,500
013-020 2 DRIVERS	40,000	2,000	8,000	8,000	8,000	8,000	6,000
13-99 Subtotal	70,000	3,500	14,000	14,000	14,000	14,000	10,500
15 Official travel:							
015-000 IN-COUNTRY TRAVEL	45,000	5,000	10,000	10,000	10,000	7,000	3,000
15-99 Subtotal	45,000	5,000	10,000	10,000	10,000	7,000	3,000
16 Mission costs:							
016-012 MISSION COSTS	45,000	7,000	15,000	10,000	7,000	6,000	
016-030 EVALUATION	45,000					25,000	
16-99 Subtotal	90,000	7,000	15,000	30,000	7,000	31,000	
17 National Professionals:							
017-001 NAT. PROJ. MANAGER	200,000	10,000	40,000	40,000	40,000	40,000	30,000
017-002 OUTREACH ADVISOR	60.0	3.0	12.0	12.0	12.0	12.0	9.0
	90,000		12,000	22,000	22,000	22,000	12,000
	48.0		6.0	12.0	12.0	12.0	6.0
	50,000	2,500	10,000	10,000	10,000	10,000	7,500
017-003 NAT. PROJ. OFFICER	60.0	3.0	12.0	12.0	12.0	12.0	9.0

PROJECT BUDGET COVERING UNDP CONTRIBUTION (in U.S. dollars)

COUNTRY : ZIMBABWE DATE PRINTED: 02/07/92 PAGE 2
 PROJECT NUMBER : ZIM/92/GI/A/1/G/01 SHADOW BUDGET
 PROJECT TITLE : PHOTOVOLTAICS FOR HOUSEHOLD AND COMMUNITY USE IN ZIMBABWE LAST REV.: 02/07/92

PROJECT COMPONENT	TOTAL AMT M/M	1992 AMT M/M	1993 AMT M/M	1994 AMT M/M	1995 AMT M/M	1996 AMT M/M	1997 AMT M/M
017-040 SHORT-TERM CONS.	90,000		50,000	20,000	20,000		
17-99 Subtotal	18.0	10.0	4.0	4.0			
	430,000	12,500	112,000	92,000	92,000	72,000	49,000
	186.0	6.0	40.0	40.0	40.0	36.0	24.0
019 COMPONENT TOTAL	1,005,000	100,500	306,000	258,500	138,000	139,000	65,000
	220.0	12.0	55.0	51.0	41.0	37.0	24.0
020 SUBCONTRACTS	20,000		5,000	5,000	5,000	5,000	
023-000 LOC. SUBCONTRACTS							
029 COMPONENT TOTAL	20,000		5,000	5,000	5,000	5,000	
030 TRAINING							
032-000 STUDY TOURS	60,000	5,000	25,000	20,000	10,000		
033-000 IN-COUNTRY TRNG.	90,000		20,000	20,000	20,000	30,000	
039 COMPONENT TOTAL	150,000	5,000	45,000	40,000	30,000	30,000	
040 EQUIPMENT							
041-000 EXPENDABLE	50,000	5,000	15,000	15,000	10,000	5,000	
041-020 VEHICLES	130,000	130,000					
042-020 OFFICE EQUIPMENT	20,000	20,000					
042-030 TEST EQUIPMENT	50,000		30,000	20,000			
042-040 VEH. FOR INSTALLERS	200,000	200,000					
042-050 PV COMPONENTS	4,550,000	500,000	2,050,000	1,000,000	1,000,000		
049 COMPONENT TOTAL	5,000,000	655,000	2,295,000	1,055,000	1,010,000	5,000	
050 MISCELLANEOUS							
051-000 O&M	190,000	35,000	45,000	45,000	45,000	20,000	

PROJECT BUDGET COVERING UNDP CONTRIBUTION (in U.S. dollars)

PAGE 3

LAST REV.: 02/07/92

DATE PRINTED: 02/07/92

COUNTRY : ZIMBABWE

SHADOW BUDGET

PROJECT NUMBER : ZIM/92/G31/A/10/01

PROJECT TITLE : PHOTOVOLTAICS FOR HOUSEHOLD AND COMMUNITY USE IN ZIMBABWE

PROJECT COMPONENT	TOTAL AMT M/M	1992 AMT M/M	1993 AMT M/M	1994 AMT M/M	1995 AMT M/M	1996 AMT M/M	1997 AMT M/M
052-000 REPORTING	7,000		10,000	10,000	10,000	10,000	7,000
053-000 SUNDRIES	50,000	10,000	10,000	10,000	10,000	10,000	10,000
058-000 Agency Support Costs	578,000	75,140	236,980	127,160	109,820	17,340	11,560
059 COMPONENT TOTAL	825,000	120,140	291,980	182,160	164,820	47,340	18,560
099 BUDGET TYPE TOTAL	7,000,000	880,640	2,942,980	1,520,660	1,347,820	226,340	81,560
	220.0	12.0	55.0	51.0	41.0	37.0	24.0
999 UNDP TOTAL	7,000,000	880,640	2,942,980	1,520,660	1,347,820	226,340	81,560
	220.0	12.0	55.0	51.0	41.0	37.0	24.0

**GLOBAL
ENVIRONMENT
FACILITY**

Zimbabwe

Photovoltaics for Household and Community Use

Project Document

*This Project Document has been edited to facilitate public dissemination.
The original is on file in the GEF Office at UNDP Headquarters in New York.*



ABBREVIATIONS AND ACRONYMS

CIDA	Canadian International Development Agency
DANIDA	Danish International Development Agency
DOE	Department of Energy
EAG	Executive Advisory Group
GEF	Global Environment Facility
GTZ	Gesellschaft fuer Technische Zusammenarbeit
kWh	Kilowatt-hour
MOT	Ministry of Transport
mW	Megawatt
NGO	Nongovernmental Organization
NPM	National Project/Programme Manager
NRSE	New and Renewable Sources of Energy
PMU	Programme Management Unit
PTC	Post, Telegraph and Communications
PV	Photovoltaics
SADCC	Southern Africa Development Coordinating Conference
SCOTFIN	Scotfin Ltd.
SIA	Solar Industries Association
UNDESD	United Nations Department for Economic and Social Development
ZESA	Zimbabwe Electricity Supply Authority
ZIMBANK	Zimbabwe Banking Corporation Ltd.

UNITED NATIONS DEVELOPMENT PROGRAMME

GLOBAL ENVIRONMENT FACILITY

Project of the Government of Zimbabwe

Title: Photovoltaics for Household and Community Use

Number: ZIM/92/G31/A/1G/01

Duration: Five years

Project Site: Zimbabwe

UNDP Sector: Energy

Subsector: New and Renewable Sources of Energy

**Government
Implementing Agency:** Ministry of Transport (MOT): Department of Energy (DOE)

Executing Agency: United Nations Department for Economic and Social
Development (UNDESD)

**Estimated Starting
Date:** September 1992

Government Inputs: Zim \$2 million (US \$382,650)

UNDP/GEF Inputs: US \$7 million

Brief Description:

This programme is intended to strike a balance between development and environmental concerns by using a sustainable model of solar electricity dissemination in Zimbabwe's rural areas to address the issue of global warming and greenhouse gas (GHG) emissions.

The programme will enable the country to:

- Reduce the need for conventional electrical grid extension while immediately displacing carbon emissions from kerosene and candles

- Enhance and upgrade its indigenous solar manufacturing and delivery infrastructure through technical assistance, technician training, and provision of critical inputs to alleviate constraints on manufacturing
- Develop an expanded commercial market in rural areas for affordable domestic solar electric lighting systems by providing low-interest financing through existing institutions to allow householders to purchase home solar systems
- Establish new credit mechanisms at the grassroots level that will benefit lower income groups in rural areas.

A. CONTEXT

1. Description of subsector

Energy consumption in Zimbabwe is six times the average for Sub-Saharan countries. The Zimbabwe Electricity Supply Authority (ZESA), a parastatal company formed in 1986, is responsible for supplying and managing the country's electrical system.

Installed electrical capacity is currently 1,961 megawatts (mW). Of this, 50 percent is derived from coal-powered thermal stations at Hwange, 16 percent from old thermal stations and 34 percent from the Kariba hydropower station. As much as 30 percent of total supply is imported from Zambia's share of the Kariba power generating system.

Eighty-four percent of Zimbabwe's electricity is consumed by industrial and commercial customers in the manufacturing and mining sectors. The remaining 16 percent is used by residential consumers, virtually all of whom live in urban areas or on commercial farms. Transmission and distribution line losses are approximately 9 percent, a relatively low figure on a continent where such losses may run to 60 and even 80 percent.

At present, approximately 20 percent of Zimbabwe's households have access to electricity, and only 16 percent of rural growth centres have grid electricity. With an average rural population density of just nineteen inhabitants per square kilometer, rural electrification is extremely expensive and energy consumptive. The rural population living in areas served by electricity is approximately 155,000, less than 3 percent of the district council/resettlement population of 5.2 million. Approximately 6 percent of households in electrified centres are actually connected, indicating that the proportion of the district council/resettlement population benefiting from electricity is only about 0.2 percent.

In 1984, the government launched a programme of rural electrification to improve the standard of living in rural areas and to increase the rate of economic growth and employment generation. Between 1984 and 1988, the government spent approximately \$10 million on rural electrification before putting the programme on hold due to a lack of funds. (Note: all figures are in U.S. dollars. Zim dollar (Z\$) conversions are provided where necessary.)

Rural electrification is aimed at providing electricity to selected rural growth centres through extension of the national electrical grid. Seventy-two such centres were targeted but by 1987, only half of these had been connected. Moreover, arrival of the grid has not made electricity more accessible to the vast majority of rural households in these areas. By mid-1987, an average of only ten households per centre were connected to the grid at an estimated cost (including distribution, line extension and hookup) of \$6,000 per household.

Demand for electricity will soon exceed ZESA's capacity; by the year 2000, demand is expected to reach 2,362 mW.

2. Host country strategy

"Growth with equity" is the official development strategy of the government of Zimbabwe. With over 75 percent of the country's population living in rural areas, the government focuses a proportional amount of attention on the delivery of basic services to rural people. Electricity is seen by the government as a critical component of rural development.

The government regards rural electrification as a way to slow rural-urban migration, reduce fertility, increase literacy and improve the overall life of the nearly 8 million people who live in rural areas, virtually all of whom are without access to grid-supplied electricity.

Electrification of households, small businesses and community service facilities is a prime national objective and one of the most pressing challenges facing the government today. With the publication by the Ministry of Transport (MOT) of the Electrification Master Plan in December 1991, the government is focusing its attention on the problem of electricity for rural Zimbabweans.

3. Prior or ongoing assistance

The World Bank is negotiating the final component of an overall \$30 million loan for rehabilitation of the existing transmission and distribution system. This loan did not, nor will it in the future, aid grid extension.

The Canadian International Development Agency (CIDA) has an industrial energy conservation project in Zimbabwe operated through the Southern Africa Development Coordination Conference's (SADCC) Harare office.

Deutsche Gesellschaft fuer Technische Zusammenarbeit (GTZ) is providing assistance and follow-up of the rural electrification masterplan study. GTZ has assisted the Department of Energy to establish a database on photovoltaic (PV) installations in Zimbabwe, which will be an invaluable aid to the GEF PV programme.

4. Institutional framework for subsector

ZESA manages Zimbabwe's electrical generating facilities and distribution systems, along with the country's rural electrification programme. ZESA is one of the best managed utilities in Africa.

MOT sets operational guidelines for ZESA and overall energy policies for the country. MOT's Department of Energy (DOE) works closely with ZESA on planning and development.

The DOE has four departments, including Research and Development, to which solar activities are attached. The department's total annual research and development budget is less than \$25,000. The GTZ assists the department with a project called Energy Programme Zimbabwe, for which it has seconded two GTZ personnel. The Energy Programme Zimbabwe has contracted a Zimbabwean consulting firm to assist in a study on the dissemination of PV in the rural areas of Zimbabwe.

The DOE has officially endorsed the use of PV to provide access to electricity in isolated rural areas, noting in a project proposal (Enhanced Solar Photovoltaics Development in Zimbabwe) that the demand for PV systems in the country is very large. This DOE PV project proposal advocates setting up local quality control and evaluation standards and verification systems, including local PV component standards and testing, as well as the proper rural credit facilities to guarantee the ability of the rural end-user to buy the equipment.

Government agencies actively engaged in rural development include the:

- Ministry of Lands, Agriculture and Rural Resettlements through AGRITEX; the Agricultural Development Authority (ADA), and the Agriculture Finance Corporation. These institutions deal directly with the majority of Zimbabwe's population living on small family farms in the rural areas and on communal lands.
- Ministry of Community and Cooperative Development, which has extension offices in all eight provinces, and provides advisory and auditing services to local cooperatives and credit institutions.
- Ministry of Local Government, which interacts with people at the grassroots level through the district councils.
- Small Enterprise Development Corporation, which makes grants and loans to small businesses and entrepreneurs.

Numerous private nongovernmental organizations (NGOs) are interested in rural energy development, appropriate technology and energy planning. These include Environmental Development Action in the Third World (ENDA), Zimbabwe Energy Research Organization (ZERO), Silveira House, the Southern Centre for Energy Development, Africa 2000, World Vision, the Biomass Users' Network, the Solar Energy Society of Zimbabwe and the Solar Industries Association (SIA) of Zimbabwe.

B. PROJECT JUSTIFICATION

1. Problem to be addressed and the present situation

About seventy percent of the people in developing countries have no access to electricity. As this demand is met and continues to increase through population growth and economic development, GHG emissions will also increase. According to current projections, the greatest growth in GHG emissions over the next thirty years will occur in developing countries.

Increased energy efficiency can result in immediate energy savings and offset the need for future capacity in the same market. But this would only address a small part of the real problem, which is the future demand for basic electrical service by the vast unelectrified majority in these countries, and the ways in which that demand can eventually be satisfied in a sustainable, environmentally acceptable manner.

Meeting the combined demands of energy conservation, environmental preservation and economic development is an especially significant challenge for Zimbabwe. Despite having one of the largest power systems in Sub-Saharan Africa, Zimbabwe has not been able to meet the energy needs of the great majority of its people.

Looking toward the future, Zimbabwe has several alternative sources for generating additional power. Exploiting two of these - the potential for hydropower and the vast reserves of coal (estimated at 30 billion tons with proven exploitable reserves of 2 billion tons) - can have serious environmental consequences. Should Zimbabwe choose to increase its coal utilization at power plants such as Hwange I and II in order to satisfy the need for rural household electrification, it would do irreversible damage to its own environment while contributing to global warming. For this reason, Zimbabwe's coal and hydropower resources should be conserved for industrial needs and used to provide economic growth in urban and semi-urban areas.

A third source of available energy - solar power - can enable Zimbabwe to reduce its reliance on coal, avert atmospheric and other forms of environmental degradation that would result from conventional power sources, and still provide electricity for the majority of its population. With an average of 3,000 hours of sunshine per year falling at the rate of up to 2,200 kilowatt-hours (kWh) per square meter, Zimbabwe's solar radiation is 20 to 25 percent higher than in East or West Africa, and is surpassed only by Arabia and the American Southwest.

Current extent of PV use in Zimbabwe

At least 3,000 PV systems have been installed in rural and semi-urban homes, rural health clinics, rural stores, beer parlours and entertainment centres, in schools and for telecommunications purposes. About one-third of home solar systems are purchased by urban area workers for their rural relatives or families. Many others are purchased by rural civil servants with regular incomes.

Of an installed capacity of 151 kilowatt-peak analyzed to date by the DOE, 41.8 percent is used for lighting, not counting PV used by Post, Telegraph and Communications (PTC), the National

Railways of Zimbabwe and the Zimbabwe National Army. Domestic home lighting constitutes over 23 percent of the PV market.

Currently, there is only one Zimbabwean solar module and systems manufacturing company, Solarcomm, along with smaller firms specializing in the production and installation of home and community solar electric systems. Most installations in the country are in Mashonaland and Manicaland, with only 15 percent of the systems installed in Matabeleland.

Local production capacity, using solar cells imported from Japan, is approximately 150 kW per year, although actual production is only about 80kW. Institutional PV applications are largely the result of donor projects using local design firms to install imported solar panels and components. Imports are otherwise restricted by the commodity import licensing system, foreign exchange allocations, and high duties on finished modules.

A considerable number of solar home systems are purchased with cash or credit arranged by solar dealers or through Scotfin Ltd. (SCOTFIN), the financing arm of the Zimbabwe Banking Corporation Ltd. (ZIMBANK). A huge demand has been identified by these companies, but satisfying it is constrained by insufficient foreign exchange allocations, and a lack of affordable and convenient end-user financing. As of this writing, SCOTFIN was no longer making solar loans because of high interest rates, a shortage of funds, and a reluctance to carry hundreds of additional small loans.

Forty-one percent of the cost of PV in Zimbabwe results from government taxes, tariffs and duties. As a result, Zimbabwe's solar PV systems carry the highest price tags on the continent. Evidence suggests that the market would expand, and this technology would be considerably more affordable for the average rural family, if the government were to waive these duties in the interests of social and rural energy development as has already been done in Botswana, the Dominican Republic, Kenya, Namibia and Tanzania.

Official views on the importance of PV

SADCC has recognized solar PV as "one of the most promising technologies" available in the sunshine-abundant Southern African region. However, SADCC's Energy Sector has also noted that rural energy needs are not always regarded as an integral part of the rural development process. As a result, there are often constraints to expanding the utilization of solar PV and other new and renewable sources of energy. These include:

- Lack of locally produced components and raw materials
- Lack of private sector capacity in manufacturing, distribution, installation and maintenance
- Lack of data for the design of PV systems
- Limited availability of foreign exchange
- Cost of PV
- Inadequate financing programmes
- Lack of trained manpower
- Lack of public awareness of the technology

- Lack of institutional framework to ensure quality and sustainability of new and renewable sources of energy (NRSE)
- Inappropriate import duties and sales taxes
- Lack of clear government policy.

In its recent "Study on NRSE Pricing in the SADCC Region," SADCC recommended eliminating or reducing surcharge and import duties to no more than 10 percent of the cost of PV components and products, eliminating sales taxes for NRSE technologies, eliminating foreign exchange controls, and establishing a set of installation standards determined by national energy ministries. In another recommendation, the Harare Declaration has called for "long-term loans for renewable energy investments that include the accounting of the saved costs for conventional energies into the amortization rate of renewable energy investment."

Zimbabwe's long-standing interest in solar energy was expressed by the Permanent Secretary for MOT/DOE in Harare in November 1991, while chairing a three-day International Solar Energy Conference on Economic and Political Initiatives for Application of Renewable Energies in Developing Countries. At that session, the Permanent Secretary called for a "solar light revolution to bring civilization to the many dark corners of Zimbabwe." Photovoltaics, he added, "can provide this light and fill the gap between no electricity and the national electric grid." He predicted that by the year 2020, every household in rural Zimbabwe could be illuminated with solar electricity.

A DOE-sponsored national PV workshop identified numerous advantages of PV systems relative to present services. Among these were the better quality of light; continuous service; convenience; lack of smoke, fumes and danger of burning; and the reduction of urban-rural disparities.

In October 1991 Zimbabwe's PV manufacturers, design and installation firms, and other interested parties gathered for a one-day workshop sponsored by the DOE. The workshop advocated the formation of a Zimbabwe Solar Industries Association, which has now been established, and which will play a key role in this project. Noting that PV is a viable option to bring about decentralized rural electrification with the kind of power requirements most commonly needed by small-scale rural users like homes and shops, the workshop recommended that:

- PV equipment should be put on the Open General Import License and special consideration should be given to the reduction of duties, tariffs and taxes
- Local technology and systems components should be improved to provide greater reliability
- Zimbabwe's PV business should be more decentralized to provide better marketing and service
- Credit facilities must be provided, preferably through existing institutions with collateral guarantees from a supporting agency.

This was the situation regarding PV in Zimbabwe at the time of the UNDP/GEF Mission in November-December 1991.

2. Expected end-of-project situation

By the completion of this five-year project, a number of significant advances should have been made:

- As many as 25,000 rural homes should have been directly illuminated. An equal number of PV systems should also have been indirectly sold as a result of the programme. (Experience gained in the Dominican Republic, Kenya and Sri Lanka indicates that two cash customers come forward for every person buying on credit when both financing services and technology are introduced in a rural area.)

Available funds from the programme are sufficient to install up to 9,000 home solar systems of 45 watts (W) each at current prices. As the revolving fund is replenished by consumer down payments of \$100 plus installment fees, the fund will provide for an additional 5-6,000 systems over the project period, depending on the inflation rate and currency stability. Furthermore, should half of the 9,000 initial systems be no larger than 20 W (including battery-charging operations), another 5,000 or more households could receive electric light and power for radios under the programme.

- A sufficiently large number of households and community institutions will have received solar electric systems through this pilot programme. This will allow for a valid assessment and demonstration of the technology and the various approaches to its promotion and dissemination.
- Capacity-building through the existing solar manufacturing industry, commercial financial institutions, government ministries and agencies, district councils, NGOs and ZESA will demonstrate that solar PV can play a key role in Zimbabwe's energy future while enhancing economic development. The resulting expanded use of solar PV will be a model for sustainable rural energy development throughout the region and the world.
- This appropriately scaled renewable energy technology will demonstrate that it can effectively meet most rural household needs for electricity in a way that does not harm the environment.
- Operating under an Economic Structural Adjustment Programme, liberalized trade laws, a market economy, and available credit through ongoing revolving credit funds, the commercial solar industry should be able to offer home solar systems to rural people at affordable rates.
- Prices should drop as a result of open competition and an expanded market. Prior to the recent Zim dollar devaluation, costs were approximately \$600 for a 45 W system including four 20 W fluorescent lights, wiring switches and installation.

- A positive climate should be achieved for financial investment in projects and institutions that are attractive to the World Bank and to commercial investors. The Zimbabwe-based solar industry should be able not only to serve its local market, but export through the countries in the SADCC region.
- Funds remaining in Zim dollars in the revolving fund at the end of the programme will be allocated by the DOE to an institution involved in further dissemination of solar home systems. Any recurrent costs attributable to the programme after its termination may be covered by remaining funds at the discretion of the DOE.

3. Target beneficiaries

The target beneficiaries will be people living in unelectrified rural areas, especially those who, with the assistance of concessional financing mechanisms, can afford to purchase their own 20 to 50 W solar electric lighting systems. As already noted, 0.2 percent of the 5.2 million people living in communal and resettlement areas are connected to grid power. Another 155,000 people have access to the grid power supply, but remain unconnected.

The programme will also attempt to target the "true" rural poor - the 80 percent without PV purchasing power - by helping to develop and produce very small 5, 10 and 15 W lighting systems along with affordable hire purchase financing. These very small systems, over 500 of which have already been sold in Zimbabwe, provide the proverbial "light over the kitchen table" allowing children to study, the family to gather, a radio to be played.

Income levels will be one criterion for targeting markets and market areas. In addition, beneficiaries should live at least 5 kilometers beyond the nearest main power line. Employment rates, commercial farming activities and the existence of NGO- or government-sponsored community development activities may also help determine criteria. The commercial marketplace will self-select scattered beneficiaries throughout the country.

Since several hundred thousand people live in semi-urban areas where power is available but where ZESA has not been able to afford household hookups, one or two such peripheral urban residential areas will be targeted as a proof-of-concept alternative to grid hookup. Homes that are clustered in communal areas near district and rural service centres will be ideal targets. At least three communities of 100 to 500 houses each will be identified, and the goal will be to electrify virtually every house.

Decisions regarding geographic target areas will be left to the Provincial Development Councils, the Programme Management Unit (PMU) and the Executive Advisory Group (EAG). A vigorous awareness campaign will be undertaken so that all eight provinces may receive a share of the PV systems.

Ten percent of the available development funds will be allocated for community use, including clinics, hospitals, schools and community centres. By allowing the technology to be demonstrated and observed, schools and clinics are often catalysts for further solar development in a given area.

Traditionally, such institutions have been the beneficiaries of donor aid projects which provide complete solar systems gratis. This project, however, will require each community institution to pay for service, thus permitting them the same access to the revolving fund at the same concessional rates as individual consumers. These systems will cost a great deal more than a typical home solar system, and funds will be loaned to qualified community associations accordingly.

Costs and ability to pay

The fee for being connected to the electrical grid is \$125 plus ongoing monthly bills of \$10 to \$15. This is more than many people can afford. In addition, because most grid-connected rural families have very low consumption rates - less than one kWh per day - the cost of being hooked up to the grid cannot be justified.

By contrast, a 45 W photovoltaic system, purchased with a \$100 down payment and paid for over thirty-six months at \$15 per month, will provide sufficient power for twenty years with only minor maintenance and occasional battery replacement.

A 1991 DOE PV workshop analyzed three sizes of domestic lighting systems - 20, 50, and 100 Watt-peak (Wp) - and their costs to the consumer compared to their present energy expenditures for kerosene, dry cells, candles and car batteries (carried to and from garages for charging). The study found that 70,000 households would be ready cash customers for 50 Wp systems. Twenty percent of the population of rural areas was found to have sufficient purchasing power to acquire home solar systems through hire purchase.

The study recommended that the remainder of the rural population without sufficient purchasing power - nearly 80 percent - be serviced through solar-powered battery charging stations. These stations could use six 45 Wp panels to charge fifty small deep-discharge solar batteries. These batteries would be leased to clusters of fifty families; every ten or fifteen days the batteries would be returned for recharge or exchange, with a cost per family of \$2 to \$3 per month. The batteries for this programme would be manufactured in Zimbabwe.

The Electrification Master Plan identified a clear ability-to-pay and a willingness-to-pay for electricity (either grid extension or PV). The document points out that non-electrified households average higher monthly energy bills than electrified households. Batteries for powering radios and televisions (both dry cell and automotive) account for an average of 48 percent of monthly energy expenditures, while candles and paraffin account for 30 percent. Excluding firewood costs, non-electrified families pay more for energy than do ZESA's customers. The average lighting cost for a non-electrified family living in a rural centre is \$16 per month.

In addition to consumer savings, considerable foreign exchange will be saved as the one-time outlay for imported PV equipment is much less than the cost of a family's twenty-year supply of imported kerosene.

No funds will be made available through the programme for mini-grid or micro-grid systems. Numerous United Nations and World Bank studies have concluded that PV village electrification is

more viable using individual (stand-alone) unconnected PV systems than a mini-grid powered by a single large PV system or mini-utility.

4. Project strategy and institutional arrangements

In order to achieve results in the most cost-effective manner, this programme will utilize Zimbabwe's existing commercial sector delivery infrastructure. As the Secretary for Energy has stated, "It will be the private commercial sector who will be instrumental in delivering photovoltaics to the people." This is government policy as well as the intention of this project.

The project will utilize its equipment procurement capacity to maximum advantage to provide the necessary imported hardware, components and commodities required for the production of solar electric systems. Equipment delivered to the project will be made available to ZIMBANK or other such entity as the government designates. This entity, in turn, will arrange for its transfer to manufacturers and suppliers on payment of the landed costs to a revolving fund maintained by ZIMBANK in Zim dollars. The revolving fund will be administered entirely by ZIMBANK and will be used to extend consumer credit through ZIMBANK and its financing arm, SCOTFIN, for end-user purchases of the home solar and community PV systems.

Severe foreign exchange restrictions have inhibited the local solar industry, which has not been able to meet demand because 60 to 70 percent of its product is imported. Import license restrictions are a second inhibitor. To avoid this, critical inputs will be made available to local suppliers; simultaneously, local funds will be provided to credit institutions to on-lend to consumers.

The executing agency will take responsibility for procurement of equipment through a flexible arrangement with established local companies. The national project director will consult with the local companies in determining equipment specifications and will forward these to the United Nations Department for Economic and Social Development (UNDESD) for procurement action. The local module manufacturers, suppliers and installers will receive their allocation through the PMU.

ZIMBANK will manage the account directly from its main office in Harare. ZIMBANK was selected because the majority of its shares are owned by the government and it has considerable experience in lending in the domestic solar market.

SCOTFIN and the bank's branch offices will manage three basic financing schemes:

- Dealer financing for aggregate loans through block discounts involving 50 to 100 consumers handled by PV suppliers/installers
- Individual consumer financing for solar systems using the solar panel as collateral
- Loans to institutions (such as schools, churches and clinics) and community associations (grassroots revolving credit funds) backed by a loan guarantee from the programme fund.

ZIMBANK will cover its costs through a management fee, and SCOTFIN will be compensated through the interest charged to consumers at a rate to be decided by the project management in consultation with the EAG. (Commercial interest rates currently range from 28 to 40 percent, rendering the consumer finance market inactive.)

Quality, capacity, availability and further criteria set by the EAG and SIA will determine how procurement will be divided between:

- Balance of systems components such as batteries, charge regulators, wiring and switches
- Solar cells, aluminum, low iron glass and tedlar plastic sheet for manufacturing
- Finished modules and complete systems for independent suppliers.

Project equipment will be procured by UNDES and will be exempted from import tax, surtax, and duty, since the project is donor-funded.

Similarly, the National Project Manager (NPM) will seek to negotiate a reduction or elimination of selective import duties, surcharges and sales taxes on all solar hardware. This is the policy of the Ministry of Transport, which has stated: "Given the essential role that PV can play in the social and economic development of rural areas, and in the interest of equity, every effort should be made to reduce the restriction that tax and duty place on the access lower income rural people have to this technology." As mentioned before, duties, surcharges (a blanket 20 percent for all imports) and sales taxes currently represent 41 percent of the cost of a solar electric system in Zimbabwe.

A second direct recipient will be ZESA, which will have allocated to it up to Z \$3 million (US \$573,970) in equipment to put in place through its own programme as many as 1,000 systems of 45 W each in target areas lying just beyond its grid. In this regard, ZESA will cooperate with the executing agency, with funds provided directly from the ZIMBANK Zim dollar revolving fund. Solar electric systems will be provided to ZESA by the private sector and either installed by them, or by ZESA's trained technicians. ZESA will be allocated its share of the programme based on an acceptable plan submitted to the PMU, with the planning process funded by a small grant from the programme.

ZESA will decide whether to lease or sell systems to its customers. ZESA has the advantage of being able to amortize the cost of household systems over ten or twenty years, thereby requiring only a small monthly payment by householders to its district offices, either directly or through the PTC Bank.

A third group of recipients may be district councils, local solar energy credit associations, the Agriculture Finance Corporation, or NGOs. These will access the Zim dollar account pursuant to approval of marketing plans by the PMU and NPM. One or more subcontractors will engage in managing the programme's "third approach" of community development as mandated in the project brief. An amount to be agreed upon by the EAG will also be reserved for this approach, in addition to the provision of community development assistance from the PMU and consultants.

The SIA will recommend which companies qualify to participate in the programme by virtue of product and installation standards, marketing ethics and performance. The EAG will review and endorse the association's recommendations.

To meet the goals of the programme, the participation of most of the existing companies and perhaps a few new ones will be required. In addition to the sector's regular business, between fifteen and twenty installations a day, for at least 200 days a year, will be necessary during the three-year implementation phase.

The commercial manufacturing sector will have access to equipment worth approximately \$4.8 million, and end-users serviced by the private sector will have access to as much as Z \$22 million (US \$4,209,100) at current rates of exchange (after subtracting the Z \$3 million (US \$573,970) set aside for ZESA).

Implementation arrangements for the programme include setting up under the implementing agency (MOT), at arms-length, a separate programme management unit, the PMU, as mentioned above. The unit will have an office in central Harare with separate phones. The-programme funds will provide furniture, phones, transport and fuel, and computers to the PMU.

Attached to this unit will be the UNDESSED's NPM, a national to be recruited locally, with the approval of the MOT, and paid in Zim dollars by the executing agency. The NPM is responsible and accountable to the UNDESSED for the overall programme, including financial, administrative and technical activities. The NPM will cooperate closely with the MOT and DOE. The NPM's counterpart at the DOE will be the Director of Energy.

Also attached to the PMU will be a full-time national project officer hired by the executing agency and paid in Zim dollars. A secretary and drivers will be hired by the NPM and paid in local currency. A vehicle will be provided to the NPM along with several vehicles provided to the unit for the primary purpose of visiting rural areas. One vehicle from this allocation will be provided directly to the DOE and kept at its premises for visits to rural areas to monitor the project.

Seconded to the unit will be several staff researchers, analysts and programme officers from the DOE, as the ministry's in-kind contribution to the programme. An important role of the DOE personnel will be the monitoring of the programme through periodic site visits, and the enforcement of standards. They will receive per diem and expenses from the programme for travel on behalf of the PMU. Several vehicles will be provided to the PMU and DOE for official use (as grants to the government).

The PMU will also include a national expert who will be responsible for day-to-day programme management, especially outreach activities in the field. The purpose of this national outreach expert will be to provide expertise in PV and rural energy development to the programme. He will report to the NPM, and will have an annual contract, renewable for a maximum of four years. Either an individual or an organization may be subcontracted. Other short-term national consultants are provided for in the budget for particular services apart from programme management.

There will also be one international expert in PV engineering. This expert, reporting to the NPM and the outreach programme manager, will provide specific technical services, including the organization of a standards programme, technical training, the development of inexpensive small solar lighting systems, socialization and diffusion of solar technology, and the facilitation of community interaction at the village level. The international expert's contract will be for two years only.

Funds will be allocated for several national consultants/task managers or firms to handle other aspects of the programme, including training, public awareness, media liaison, video production, publication of materials, education and community development. United Nations volunteers may also be attached to the PMU to perform specific assigned tasks.

Finally, an EAG (or "operations group" or "steering committee") will be formed to advise and recommend on policy and operations to the PMU. The six-member EAG, which will meet monthly or when required, will include the Director of Energy, the NPM, the outreach expert, and a representative each of SIA, ZESA and ZIMBANK. This group will approve all policy decisions and arbitrate differences of opinion likely to arise in such a joint venture between the public and private sectors.

Numerous other strategies and implementation approaches were considered in great detail by the UNDP/GEF Mission in consultation with the MOT, the DOE and local businessmen. It was recognized by all parties that the ministry and the DOE had experience in the area of renewables and considerable interest in PV applications in rural areas, but that they could not directly manage a programme of this magnitude, nor afford to pay the required management personnel. It was also recognized that this programme would have to be run by Zimbabwe and not by outside agencies, international consulting firms or expatriate managers, although certain international experience would be necessary and welcome. The mission team also agreed that extremely well-qualified, talented and trained personnel existed in Zimbabwe, with enough direct experience in PV and rural energy development to successfully operate the programme throughout its life.

5. Reasons for assistance from UNDP/UNDES

Environmental concerns and the need to address the issues of development and environment together prompted the government of Zimbabwe to request special development assistance under the guidelines of the GEF.

Through the offices of the Ministry of Environment and Tourism, whose Permanent Secretary is a member of the GEF Participants' Committee, a proposal for a PV project for Zimbabwe was tendered to the GEF early in 1991. The GEF Coordinator for Africa proceeded, with the assistance of the Solar Electric Light Fund, and support from the United Nations Department of Technical Cooperation for Development (now the Department of Economic and Social Development), to develop a project brief for GEF consideration. The GEF Implementation Committee approved the project in October for \$7 million.

The project was referred by the Secretary of Environment to the Ministry of Transport for further consideration. The MOT offered enthusiastic support to the project, planned as a five-year programme, with special attention to ongoing infrastructure and sustainability.

Long-standing interest in PV technology within the government and the private sector led to the specific project request. Many senior officials within the government have expressed support for PV energy: ZESA's chairman and general manager have long been members of the Solar Energy Society; the Director of Energy has been involved with renewable energy projects for over a decade; the Secretary of Energy is a member of the United Nations Solar Energy Group for Environment and Development; and the Secretary of Environment has a personal interest in PV.

6. Special considerations

Women

Women will play a key role in the adoption of solar electricity in rural areas as they are likely to benefit most from it. It is usually the women who stay home with the children while their husbands go to work in the city. They also outnumber men by 100 to 70 in rural areas. Confined to dark workspaces and unable to enjoy time with their families after sunset (approximately 6:30 p.m. around the year), they are often the first to show interest in solar lighting. Women's organizations at the national, provincial and district levels may thus become involved in the programme at the request of the PMU.

The environment

The environmental implications of this programme are significant. If, as a result of this programme, 10,000 households begin using solar electricity, the amount of kerosene burned per year per household will decrease by nine gallons. This will annually prevent about 400 tons of carbon from being released into the atmosphere. Also, at a household usage rate of ninety-six environmentally dangerous dry cell batteries per year, these 10,000 households will prevent nearly 5 million dry cells over five years from being disposed of in ditches and garbage dumps. Hydrocarbon emissions from as many as 15 million candles will also be displaced.

A technical review of ZESA's emissions will be conducted during the programme to indicate the degree to which GHGs have been offset by attendant grid displacement.

Economic development

This programme focuses on developing a solar energy delivery infrastructure, including technical training and support for microenterprises. The solar panels and systems required for implementation of the programme may be purchased from the country's only indigenous assembly plant, which will be favoured in the programme, or they may be imported. In either case, an indirect result of the effort will be to rapidly commercialize an already existing small PV industry.

7. Coordination arrangements

Government agencies

Apart from coordination of the programme with ZESA, district councils, NGOs, government agencies and community development associations as described above, it will be advantageous for programme managers to link up with the Ministry of Community and Cooperative Development, which has extension services in all eight provinces.

The Ministry of Information, a strong supporter of solar energy development, may prove helpful in providing educational materials and liaising with government media.

The Ministry of Local Government should be approached to assist with development efforts focused at the district council level.

SADCC

Liaison with SADCC will be important as member states will be watching the programme closely. At a workshop held in Swaziland, Renewable Energy and the Utilities in the SADCC Region, the GEF PV programme was discussed at length, with much interest exhibited by representatives of SADCC utilities and energy ministries.

NGOs

The Danish International Development Agency (DANIDA), GTZ, CIDA and the Swedish International Development Agency (SIDA), have small renewable energy programmes in development stages, and it will be important to keep them informed of the progress of the programme and explore common interests and activities.

DANIDA is engaged in a current project to rehabilitate Solarcomm's manufacturing capacity, and provided new equipment, foreign exchange loans and technical transfer to the company early in 1992.

Other coordination efforts

The programme will sponsor a workshop for NGOs and the donor community in 1992 or 1993 to familiarize Zimbabwe's numerous aid and development organizations with PV technology. It is hoped that they will introduce PV themselves in communities where they already have projects (to be financed through their own resources unless they have qualified as participants in the programme itself, which one or two may do). This workshop may be repeated as a regional exercise in 1994.

Agricultural institutions, shows, fairs and credit bureaux may be asked to play a role in the dissemination of the technology.

8. Counterpart support capacity

The government has offered in-kind support of at least Z \$2 million (US \$382,650) during the life of the programme, as well as to cover any recurrent costs following its termination. This will be largely in the form of salaries to DOE employees seconded to the project, mainly for monitoring efforts, and other local miscellaneous expenses.

9. Possible follow-up

The World Bank may provide additional financing of up to \$15 million in concessional loans or GEF grants in 1994, provided that a successful investment model - either commercial, government-sponsored or parastatal - has been identified within the first two years of the programme.

A video production will be undertaken during the course of the programme to be used as an educational tool around the world to promote global dissemination of solar electrification. Supplemental funding for this project will be sought.

The 1995 World Solar Congress of the International Solar Energy Society will be held in Harare, providing a timely opportunity for Zimbabwe to showcase its GEF programme of solar rural electrification.

C. DEVELOPMENT OBJECTIVE

The development objective of this project is to supply basic electrical service to rural populations lacking access to grid extension. This will be done in an environmentally benign and affordable manner by substituting kerosene and conventionally generated electric power with solar electric power. The programme will serve as a demonstration of an alternative to planned grid extension.

This objective is consistent with the policy analysis made by the Kennedy School of Government at Harvard University for the United Nations Centre for Science and Technology for Development (1990):

Photovoltaics can play an important role in providing electricity to rural areas of Zimbabwe. Under certain conditions of low population density and low electricity demand, PV is a much more cost-effective technology than grid extension... [The] addition of PV to the current electrification strategy could thus provide substantial savings to the government. Further, photovoltaics, if provided to the rural poor at subsidized rates, is financially feasible and will permit users to be owners and managers of their own electricity resources.

The programme will use a proven, innovative and renewable technology to demonstrate new approaches to PV applications. Although PV as a technology has been applied in a variety of settings and under a variety of conditions, the approach which this project describes differs from all existing or previous efforts directed at using PV for rural electrification. It will thus serve to demonstrate an innovative and still unproven technical approach.

D. IMMEDIATE OBJECTIVES, OUTPUTS AND ACTIVITIES

OBJECTIVES

- To facilitate the installation of a minimum of 9,000 domestic solar electric systems in rural areas over three years, as well as small community institutional lighting systems. These systems will be financed through revolving fund mechanisms, which may catalyse sustainable rural energy development.
- To build and develop training, delivery, financial and institutional infrastructures for rural solar electrification that will continue beyond the completion of the project.
- To upgrade local technology and manufacturing capacity while strengthening the local solar industry and commercial sector.
- To create lasting public awareness regarding the appropriate utilization of solar electric technology.
- To employ the three approaches of programme implementation as set forth in the GEF project brief: (1) commercial/private sector; (2) utility; and (3) local community development. Once foreign exchange and consumer credit are available, local suppliers and dealers will begin marketing and installing solar PV systems nationwide.

OUTPUTS AND ACTIVITIES

Output 1

Availability of and immediate access to critical inputs for utilization by Zimbabwe's solar industry to manufacture solar products in accord with market demand and programme needs for the benefit of lower income groups in rural areas.

Activities for Output 1

- 1.1 Establish programme banking and finance procedures through ZIMBANK.
- 1.2 Establish revolving fund in Zim dollars at ZIMBANK to be utilized by programme through ZIMBANK branches and SCOTFIN.
- 1.3 Establish planning criteria, qualifications, and procedures for local industry access to equipment procurement, through the PMU and DOE to UNDES, with initial delivery to a government agency to be designated.

Output 2

Availability of and access to local commercial credit funds for end-users to purchase solar electric lighting systems.

Activities for Output 2

- 2.1 Establish a three-tiered commercial credit system at ZIMBANK/SCOTFIN for dealers, consumers and institutions. Set interest rates for revolving fund and negotiate bank handling fees, if any.
- 2.2 Qualify and inform participating solar electric dealers and installers. Since beneficiaries are the general public, especially lower income groups in rural areas, vendors taking advantage of the scheme should follow basic guidelines established by the PMU and DOE to ensure that benefits are passed on to the public. Project equipment will be exempted from import tax, surtax and duty, being a donor-funded project. The PMU will ensure that resulting cost reductions will accrue to project beneficiaries through a carefully formulated pricing structure.
- 2.3 Identify suggested target areas for commercial introduction and an intensive sales and marketing programme, which will ensure that lower income groups, especially in rural areas, will be the prime beneficiaries. This will be done in association with the NPM, PMU, DOE, and the participating dealers and installers, based on criteria to be established and agreed upon by the above. These criteria might include:
 - Living more than 25 kilometers from Harare or more than 5 kilometers from the electrical grid
 - Income levels
 - Source of income (civil service, farming, business, and so on).

At least one semi-urban high density area of 500 homes should be included since many such areas remain unelectrified despite their proximity to the grid.

- 2.4 Identify interested institutions (such as schools, clinics and community centres) to receive loans for community lighting systems to be installed by commercial dealers.
- 2.5 Provide financing for any household purchasing a PV system that also chooses to install solar hot water as a replacement for wood water heating.

Output 3

Institutional capacity through utility-sponsored dissemination, installation, financing and maintenance of an initial 1000 solar lighting systems of 45 W each as an alternative electrical system.

Activities for Output 3

- 3.1 Provide planning funds and technical expertise to the ZESA rural electrification section so it may begin to plan its project and design its installation and tariff collection programme.

- 3.2 On agreeing upon an implementation plan for installation and maintenance of PV systems in designated target areas, ZIMBANK will release funds of up to Z \$3 million (US \$573,970) over three years. This will enable ZESA to purchase hardware from local private sector suppliers, who will then be able to make corresponding procurements through the project.
- 3.3 Assist ZESA to recruit and train a PV supervisor along with one or two technicians to manage ZESA projects (chief's salary to be paid by local currency revolving fund and recovered through lease or sale of systems to consumers).
- 3.4 Require final report by ZESA regarding successes and failures of projects, and whether PV should be integrated into national energy planning; if so, how. (Responsible parties: NPM, PMU, Director of Energy and ZESA PV supervisor. Systems to be supplied by private sector, and installed by either ZESA personnel or private companies.)

Output 4

A sustainable institutional mechanism for village and district level community development or rural solar electrification, including:

- Rural council-sponsored solar credit association(s)
- Existing or special solar cooperative(s)
- Trained management personnel based in rural areas.

Activities for Output 4

- 4.1 Identify one or several district councils interested in participating in the programme and assist in designing and establishing a locally-based revolving credit system for purchase of domestic and institutional solar lighting. Provide local funds up to Z \$3 million (US \$573,970).
- 4.2 Identify one or several appropriate NGOs to assist in the establishment of local solar energy associations or cooperatives for the purpose of managing local revolving funds and making loans.
- 4.3 Identify specific communal and commercial farming target areas based on criteria developed in association with the NPM, PMU, the Director of Energy and the participating organization(s).
- 4.4 Identify interested community institutions and assist in organizing fund-raising campaigns so they may acquire solar lighting systems with a loan from the central revolving loan fund.
- 4.5 Train local personnel in fund management, PV system maintenance and repair.

- 4.6 Hold competitions among districts for rural PV development. The leading council will win a grant from the programme fund to electrify one school. (Installations by private companies.)

Output 5

Sufficient number of trained and qualified PV technicians and installers.

Activities for Output 5

- 5.1 Assist local companies in enhancing their in-house technician training.
- 5.2 Support the establishment of intensive training courses for qualified applicants.
- 5.3 Establish certification or licensing process for installers and technicians trained through the programme (in association with private sector, DOE and vocational institute).
- 5.4 Arrange for Zimbabwe publication and/or distribution of PV technical handbook *Small Solar Lighting System for Africa* by Mark Hankins.
- 5.5 Support solar industry in setting up branches or independent small-business workshops in rural areas.

Output 6

National public awareness of benefits of solar electricity and how individuals may acquire it.

Activities for Output 6

- 6.1 Prepare a national public awareness campaign for the GEF programme, highlighting its goals, the technology it is promoting and how people can participate. The campaign will use a variety of channels of communication, including television, radio, print advertising, handbills, booklets and appropriate educational materials.
- 6.2 Develop educational materials in association with the Ministries of Education, Community and Cooperative Development, Local Government and Agriculture.
- 6.3 Coordinate the distribution of materials with ZESA, participating community organizations, district councils, NGOs, government agencies and the Ministry of Information.

- 6.4 Hold annual provincial workshops for officials, NGOs, interested public, development workers and students to introduce and demonstrate technology, and report on progress of GEF programme.
- 6.5 Plan for production of video in second or third year of programme. Video to be funded supplementally and released at the 1995 Solar World Congress in Harare.
- 6.6 Hold end-of-programme three-day workshop including all involved parties to analyze and critique experience and draft final report (1996).

Output 7

Improved solar technology including charge controllers, batteries, lights and locally assembled solar PV modules. Development, manufacturing and marketing of small systems (under \$150) that provide electricity for one or two lights and a radio. Development of solar-powered battery charging system for deployment in rural areas. Improved transport capacity.

Activities for Output 7

- 7.1 Technology transfer and technical assistance from international consultant attached to programme (for two years) and other technical experts if required.
- 7.2 Travel to other countries to visit PV companies, as well as government-sponsored rural PV projects in Mexico, Morocco and Senegal, by designated PMU staff and/or Permanent Secretaries for Energy, Environment and Finance, an official from Customs and Excise Department, and several qualified industry engineers and technicians.
- 7.3 Technical cooperation between developing countries in the form of visits by foreign PV experts from countries with similar approaches to rural PV.
- 7.4 International consultant to assist local manufacturers in design, production and marketing of 5 or 10 W lighting system to reach poorest 80 percent of rural market.
- 7.5 Small grants to assist in development of ten solar-powered battery charging units, to be qualified for sale or lease to rural businesses. Approve loan to manufacturer to on-lend to local purchaser or franchisee (approximately \$7,000 per unit to service fifty low-income households).
- 7.6 Make up to \$200,000 vehicle procurements available to qualified applicants. Vehicles to be paid for in equivalent Zim dollars to central revolving fund.

Output 8

Established standards for PV equipment and components, both locally produced and imported, including licensing programme for installers and standards for installation and design. Ongoing testing programme for PV components and systems.

Activities for Output 8

- 8.1 Establish systems qualifications for programme suppliers, and set design and balance-of-systems specifications for two or three systems of sizes agreed upon in consultation with SIA and the Solar Energy Society.
- 8.2 Prepare and establish testing procedures and programme in association with Zimbabwe Standards Association or Zimbabwe Institute of Technical Studies for systems tests.
- 8.3 Send qualified components to European testing facility in Ispra, Italy, to ensure quality hardware for programme.
- 8.4 Establish national standards for PV systems components, modules, installations and training. (This will be a legacy of the programme as it will not be ready at the beginning of the systems installation phase.)
- 8.5 Develop standard required maintenance programme in association with SIA and various dealers as a stipulation to participate in project with access to credit fund.

E. INPUTS

1. Government of Zimbabwe

Department of Energy

Z \$2 million (US \$382,650)
(five years)

Programme Officer
ZESA Project Liaison Officer
Technicians for ZESA (if appropriate) (2)
Drivers and other personnel as necessary (2)
ZESA PV Supervisor (48 work-months (w/m)*)
Office accommodation, including telephones,
fax, telex services

* Salary and expenses to be paid by project to ZESA pursuant to acceptable implementation plan submitted to PMU. This could be from ZIMBANK, repayable through revolving fund.

2. UNDP

<u>Personnel</u>	<u>w/m</u>	<u>US\$</u>
Project Manager	60	200,000
National Outreach Advisor	48	90,000
Rural PV Specialist	24	220,000
Short-term Consultants (national)	18	90,000
Short-term Consultants (international)	10	150,000
National Project Officer	60	50,000
Secretary	60	30,000
Drivers (2)	120	40,000
Evaluation Missions		45,000
Travel (project personnel)		45,000
Mission Costs (agency)		45,000
Total		1,005,000
<u>Subcontracts</u>		
Local Subcontracts		20,000
<u>Training</u>		
Study Tours		60,000
In-country Training (workshops and courses)		90,000
Total		150,000
<u>Equipment</u>		
Expendable (office supplies)		50,000
Vehicles (for project management)		130,000
Office Equipment		20,000
Test Equipment and Instrumentation		50,000
Vehicles (for installers)		200,000
PV Components and Supplies		4,550,000
Total		5,050,000
<u>Miscellaneous</u>		
Vehicle Operations and Maintenance		190,000
Sundries		50,000
Report		7,000
Total		247,000
Agency Support Costs		578,000
Grand Total		7,000,000

F. RISKS

Risks associated with this programme include:

- High inflation rapidly eroding value of revolving funds
- Devalued currency increasing end-user cost of PV units
- Lack of effective local participation
- Failure to establish market incentives
- Excessively high import duties that destroy competition
- Surcharges and taxes that increase cost of technology beyond ability of rural people to afford it.

G. PRIOR OBLIGATIONS AND PREREQUISITES

1. **Prior Obligations:** None.
2. **Prerequisites:** The government has indicated its desire to reduce or eliminate import duties, tariffs and surcharges. This will be done over time as part of the Economic Structural Adjustment Programme. Eventually, necessary commodities for the manufacture of solar products will be listed on the Open General Import License. However, these reforms will not take place prior to the implementation of the programme.

H. PROJECT REVIEW, REPORTING AND EVALUATION

The project will be subject to tripartite review (joint review by representatives of the government, executing agency and UNDP) at least once every twelve months. The first such meeting will be held within the first twelve months of the start of full implementation. The programme manager shall prepare and submit to each tripartite review meeting a Project Performance Evaluation Report. Additional reports may be requested, if necessary, during the project.

A project terminal report will be prepared for consideration at the terminal tripartite review meeting. It shall be prepared in draft sufficiently in advance to allow review and technical clearance by the executing agency at least four months prior to the terminal tripartite review.

The project shall be subject to review four months after the start of full implementation. The organization, terms of reference and timing will be decided after consultation between the parties to the project document. There will be evaluation missions at the middle and at the end of the project.

I. LEGAL CONTEXT

This project document shall be the instrument referred to as such in Article 1 of the Initial Standard Basic Assistance Agreement between the Government of Zimbabwe and the UNDP, signed by the parties on 27 May, 1980. The host country implementing agency shall, for the purpose of the Standard Basic Assistance Agreement, refer to the Government Cooperating Agency described in that agreement.

J. BUDGET

A project budget, covering both government and UNDP/GEF inputs, is attached.

PROJECT BUDGET COVERING GOVERNMENT CONTRIBUTION
(in Zim Dollars)

Government Personnel	Z\$ Total m/m	1992	1993	1994	1995	1996	1997
<u>Professional Personnel</u>							
2 Project Officers (Solar)	120	320,000	16,000	64,000	64,000	64,000	48,000
1 Project Officer (Economist)	60	150,000	7,500	30,000	30,000	30,000	22,500
2 Project Technicians (Solar)	120	200,000	10,000	40,000	40,000	40,000	30,000
1 Project Officer (Liaison ZESA)	60	150,000	7,500	30,000	30,000	30,000	22,500
8 Part-time Personnel	30	604,000	30,200	120,800	120,800	120,800	90,600
<u>Administrative Personnel</u>							
1 Driver	60	36,000	1,800	7,200	7,200	7,200	5,400
1 Typist	60	60,000	3,000	12,000	12,000	12,000	9,000
Office Accommodation Telecommunications (Telephone, Fax, Telex)		240,000	12,000	48,000	48,000	36,000	36,000
Total		2,000,000	100,000	400,000	400,000	400,000	300,000

PROJECT BUDGET COVERING UNDP CONTRIBUTION (in U.S. dollars)

COUNTRY : ZIMBABWE DATE PRINTED: 02/07/92

PROJECT NUMBER : ZIM/92/G31/A/JIG/01 SHADOW BUDGET

PROJECT : PHOTOVOLTAICS FOR HOUSEHOLD AND COMMUNITY USE IN ZIMBABWE

PROJECT COMPONENT	TOTAL AMT M/M	1992 AMT M/M	1993 AMT M/M	1994 AMT M/M	1995 AMT M/M	1996 AMT M/M	1997 AMT M/M
010 PROJECT PERSONNEL							
11 Experts:	220,000	27,500	110,000	82,500			
011-001 RURAL PV EXPERT	24.0	3.0	12.0	9.0			
011-050 SHORT-TERM CONS.	150,000	45,000	45,000	30,000	15,000	15,000	
	10.0	3.0	3.0	2.0	1.0	1.0	
11-99 Subtotal	370,000	72,500	155,000	112,500	15,000	15,000	
	34.0	6.0	15.0	11.0	1.0	1.0	
13 Admin. support pers.:							
013-010 SECRETARY	30,000	1,500	6,000	6,000	6,000	6,000	4,500
013-020 2 DRIVERS	40,000	2,000	8,000	8,000	8,000	8,000	6,000
13-99 Subtotal	70,000	3,500	14,000	14,000	14,000	14,000	10,500
15 Official travel:							
015-000 IN-COUNTRY TRAVEL	45,000	5,000	10,000	10,000	10,000	7,000	3,000
15-99 Subtotal	45,000	5,000	10,000	10,000	10,000	7,000	3,000
16 Mission costs:							
016-012 MISSION COSTS	45,000	7,000	15,000	10,000	7,000	6,000	
016-030 EVALUATION	45,000			20,000		25,000	
16-99 Subtotal	90,000	7,000	15,000	30,000	7,000	31,000	
17 National Professionals:							
017-001 NAT. PROJ. MANAGER	200,000	10,000	40,000	40,000	40,000	40,000	30,000
	60.0	3.0	12.0	12.0	12.0	12.0	9.0
017-002 OUTREACH ADVISOR	90,000		12,000	22,000	22,000	22,000	12,000
	48.0		6.0	12.0	12.0	12.0	6.0
017-003 NAT. PROJ. OFFICER	50,000	2,500	10,000	10,000	10,000	10,000	7,500
	60.0	3.0	12.0	12.0	12.0	12.0	9.0

PROJECT BUDGET COVERING UNDP CONTRIBUTION (in U.S. dollars)

PAGE 2

COUNTRY : ZIMBABWE

DATE PRINTED: 02/07/92

LAST REV.: 02/07/92

PROJECT NUMBER : ZIM/92/G31/A/IG/01 SHADOW BUDGET
 PROJECT TITLE : PHOTOVOLTAICS FOR HOUSEHOLD AND COMMUNITY USE IN ZIMBABWE

PROJECT COMPONENT	TOTAL AMT M/M	1992 AMT M/M	1993 AMT M/M	1994 AMT M/M	1995 AMT M/M	1996 AMT M/M	1997 AMT M/M
017-040 SHORT-TERM CONS.	90,000		50,000	20,000	20,000		
	18.0		10.0	4.0	4.0		
17-99 Subtotal	430,000	12,500	112,000	92,000	92,000	72,000	49,000
	186.0	6.0	40.0	40.0	40.0	36.0	24.0
019 COMPONENT TOTAL	1,005,000	100,500	306,000	238,500	138,000	139,000	65,000
	220.0	12.0	55.0	51.0	41.0	37.0	24.0
020 SUBCONTRACTS							
023-000 LOC. SUBCONTRACTS	20,000		5,000	5,000	5,000	5,000	
029 COMPONENT TOTAL	20,000		5,000	5,000	5,000	5,000	
030 TRAINING							
032-000 STUDY TOURS	60,000	5,000	25,000	20,000	20,000	10,000	
033-000 IN-COUNTRY TRNG.	90,000		20,000	20,000	20,000	30,000	
039 COMPONENT TOTAL	150,000	5,000	45,000	40,000	40,000	30,000	
040 EQUIPMENT							
041-000 EXPENDABLE	50,000	5,000	15,000	15,000	10,000	5,000	
041-020 VEHICLES	130,000	130,000					
042-020 OFFICE EQUIPMENT	20,000	20,000					
042-030 TEST EQUIPMENT	50,000		30,000	20,000			
042-040 VEH. FOR INSTALLERS	200,000	200,000					
042-050 PV COMPONENTS	4,550,000	500,000	2,050,000	1,000,000	1,000,000		
049 COMPONENT TOTAL	5,000,000	655,000	2,295,000	1,035,000	1,010,000	5,000	
050 MISCELLANEOUS							
051-000 O&M	190,000	35,000	45,000	45,000	45,000	20,000	

PROJECT BUDGET COVERING UNDP CONTRIBUTION (in U.S. dollars)

PAGE 3

LAST REV.: 02/07/92

DATE PRINTED: 02/07/92

COUNTRY : ZIMBABWE

PROJECT NUMBER : ZIM/92/G31/A/IG/01

PROJECT TITLE : PHOTOVOLTAICS FOR HOUSEHOLD AND COMMUNITY USE IN ZIMBABWE

PROJECT COMPONENT	TOTAL AMT M/M	1992 AMT M/M	1993 AMT M/M	1994 AMT M/M	1995 AMT M/M	1996 AMT M/M	1997 AMT M/M
052-000 REPORTING	7,000						7,000
053-000 SUNDRIES	50,000	10,000	10,000	10,000	10,000	10,000	10,000
058-000 Agency Support Costs	578,000	75,140	236,980	127,160	109,820	17,340	11,560
059 COMPONENT TOTAL	825,000	120,140	291,980	182,160	164,820	47,340	18,560
099 BUDGET TYPE TOTAL	7,000,000	880,640	2,942,980	1,520,660	1,347,820	226,340	81,560
	220.0	12.0	55.0	51.0	41.0	37.0	24.0
999 UNDP TOTAL	7,000,000	880,640	2,942,980	1,520,660	1,347,820	226,340	81,560
	220.0	12.0	55.0	51.0	41.0	37.0	24.0