DOE/GO/10209--T1

**GORE-MBEKI BINATIONAL COMMISSION
INTEGRATED HOUSING PROGRAM
GRANT#DE-FG36-97G010209**

FINAL REPORT

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MASTER

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**GORE-MBEKI BINATIONAL COMMISSION INTEGRATED HOUSING
PROGRAM
GRANT# DE-FG36-97GO10209
FINAL REPORT**

Background

This report documents the work done under Grant # DE-FG36-97 GO10209, Innovative Renewable Energy Technology Transfer Program. PEER Consultants, PC, and its subcontractor, PEER Africa (Pty.)Ltd., received an \$88,000.00 grant to plan and build two energy efficient homes in the black township of Gugulethu in CapeTown, South Africa. These demonstration homes were given to the people of South Africa as a gesture of goodwill by the US government as part of the Gore-Mbeki Binational Commission (BNC) agreements and cooperation. The BNC is the term used to describe the agreement to work together by the US and the South African governments for economic development of South Africa in the areas of energy, commerce, agriculture, housing, and transportation. The BNC was formed in 1995. This project under the auspices of the BNC started in September 1996. The DOE-funded portion was performed between January 11, 1997 and February 28, 1997.

The Gore-Mbeki Binational Commission Integrated Housing Program was started in August 1995. This initiative is the results of a Memorandum of Understanding (MOU) signed between the Ministry of Housing, Northern Cape Province, the Community of Kutlwanong, Northern Cape Province, and PEER Africa (Pty.) Ltd. (PEER Africa). The US Department of Energy supported the MOU. The Integrated Housing Program has as its purpose the development and implementation of an integrated environmental and energy efficient housing program that is acceptable to historically disadvantaged South Africans, and can be implemented using currently available South African government funds.

In the Spring of 1995 the South African Premier of the Northern Cape Province, Manne Dipicio, made an appeal to the United States Government to focus on the Northern Cape, and to look for opportunities for research and development projects in the Northern Cape Province. As a results of that request, the Hon. Hazel O'Leary, Secretary of Energy, and the South African Department of Energy and Mineral officials visited Kimberley in the Northern Cape with a delegation of American and South African businesses to discuss energy programs and policies, and joint-cooperation efforts. At the conclusion of that visit, a MOU was signed between the Provincial Minister for Housing, Pakes Dikgetsi, PEER Africa's President, Lilia A. Abron, Ph.D., PE, the Community of Kutlwanong, and several local, black businesses. The MOU was a basic agreement to develop and implement a housing project that combined environmental awareness, energy efficiency, and affordable housing in the community of Kutlwanong, a black township.

PEER Africa had already approached the community concerning the prospects of building the first environmental/energy efficient cost optimized home termed ECOTM house, in Kutlwanong. The ECOTM housing technology is an integral part of the Holistic, Economically Sustainable, Community Development Model for Emerging Communities developed by PEER Africa. This model successfully incorporates environment, energy, housing, infrastructure, economics, social, cultural, and capacity building issues in the development and rebuilding of historically disadvantaged communities. After reviewing several housing vendor presentations, the community selected PEER Africa to serve as its community-based facilitator and to build the first ECOTM prototype in their community. The first prototype was supported under DE-FG36-97GO10182. The MOU provided the support needed to launch this project. The prototype was dedicated in March 1996. The response to the prototype was overwhelming. PEER Africa worked diligently with the community to assist them in applying for the subsidies for the houses. The building of the first 200 ECOTM homes commenced in December 1996 as a project-linked subsidy scheme. In April 1997 the community should begin the construction of the remaining 2,300 ECOTM homes. The First Technical Report documenting the Kutlwanong experience was filed under USDOE Grant Number DE-FG36-96GO10182. Several videos were also included with this report. One is a two-minute summary of the project prepared by the USDOE for presentation at the August 1996 Gore-Mbeki BNC Meetings held in America. The other is a documentary prepared in October, 1996 by the South African Broadcasting Company (SABC) on housing building programs being implemented in South Africa as part of the Reconstruction and Development Programme (RDP).

Introduction

During the November 1995 meetings described above, the energy delegation also visited the Gugulethu Township in the Western Cape Province. Secretary O'Leary and Minister of Parliament Phumzile Mlambo-Ngcuka discussed areas of mutual cooperation. Follow-up discussions were held during the August 1996 BNC meetings, and an outcome was the agreement to bring the Integrated Housing Program to the Western Cape Province and build two ECOTM homes in Gugulethu. These homes could serve as a focal point in the Local Industrial Park Concept (LIP), introduced by MP Mlambo-Ngcuka, stimulating entrepreneurial development around the delivery of homes. Appendix A, "US/RSA Gore-Mbeki Integrated Housing Program", 1997 and 1998, documents this project and program. This program integrates environmental, energy, and energy efficiency considerations with the utilisation of affordable, spacious housing, appliances such as cook stoves, water heaters, and space heaters, and low smoke/low particulate fuels. It also involves capacity building, job creation, and entrepreneurial development. It creates a framework for the introduction of applicable energy related technology to historically disadvantaged communities. Its success is highly dependent upon community self-help programs, bridge financing, and favorable pricing schemes provided by the major building materials suppliers.

At the request of the USDOE, PEER Africa agreed to develop, provide engineering, and planning support services, and construct management and oversight services for the building of the ECOTM homes in Gugulethu in time for the next series of BNC Meetings. Those meetings were planned for February 1997 in Cape Town. Minister Mlambo-Ngcuka requested that at least one of the structures be a two family unit, since the availability of land space in Gugulethu is an issue. The other structure would be a single-family unit.

An overview of the project and sketches of the units constructed in given in the Appendix A to this report.

Project Approach

The Integrated Housing Program in Gugulethu is being managed by the newly formed Community Development Corporation, which is referred to as the CDC-Gugulethu. This body is the implementing arm of the RDP Forum in Gugulethu. The CDC-Gugulethu has taken on a very ambitious program of developing a local industrial park (LIP) to speed-up housing delivery, to promote community economic enhancement resulting from housing delivery, and to promote small, medium, and micro-business entrepreneurs (SMME's). The RDP Forum has as its slogan and vision, "From Township to Suburb by the Year 2000". Thus, in-keeping with the CDC-Gugulethu vision, one of the houses will serve as an anchor at the proposed site of the LIP, and the other house will be located in the community to help stimulate the push to get homes built, and the community redeveloped. The concept for the LIP is given in Appendix A to this report.

PEER Africa reported to the CDC for the implementation of this project. The project commenced in South Africa in November 1996, and the first two months focused on securing the sites for the project. The single-family unit, Kutlwanong Model, was selected to be built on the Lansdowne Road site, which is the planned site for the LIP. That structure was built using steel framing technology and expanded polystyrene as the insulating material. It is an improved version of the structure built in the Northern Cape. It has an improved insulation system, and a modified roof system, vaulted, to improve ventilation. Modifications to the exterior wall included an increase in water proofing material under the foundation and in the exterior wall. This was done to address the prevalent high winds and rains typical of the Western Cape Province, but not of the Northern Cape Province. The home consists of a lounge, kitchen, two bedrooms, and a bathroom. The exterior can be done using any finishing material, but brick is the material being used for this unit.

The two family unit, Courtyard Model, uses a mass wall system wrapped in a skin of expanded polystyrene and water proofing material. The roof is insulated and vaulted. The house is finished in stucco and the inside walls have a skim coat of plaster covered with paint. The living space in this unit is separated, and the courtyard is fully enclosed promoting well-appreciated security and privacy. This unit also has a lounge, kitchen, two bedrooms, and a bathroom.

Appendix B shows the structures being built by the local community builders trained by PEER Africa. The training was done during actual construction of the units. Building techniques and plans for the day were discussed each day before work started. Because of language differences, and the inability of the workers to understand English well, trained builders from Kimberley were brought in by PEER Africa to work along side the Gugulethu workers. This was an excellent technique for training, since the workers spoke similar languages, and their peers were training them.

The CDC-Gugulethu, the South African Department of Trade and Industry, the city of Cape Town City Council, and the IKAPA Town Council (former provincial caretaker of Gugulethu approved the project during the Apartheid era). The Gugulethu community and ward leaders were given numerous presentations concerning the project, and as a result gave their overwhelmingly approval of the project. In January 1997 local engineering consultants, building contractors in all trades and security contractors were hired to implement this project. The project was sufficiently completed in three weeks for dedication during the BNC meetings. The completed units were later turned over to the CDC-Gugulethu for its uses in December 1997.

Summary

A primary focus of this project was to develop affordable housing that could be built within the funding limitations of the subsidy. The work done in Kimberley justified the need for the full R 15 000 to be used for the top structure only. Other financial arrangements will have to be used to pay for the land, infrastructure and services. Thus, the imperative need for bridge financing, low interest loans, loan guarantees self-help programs, capacity building, and entrepreneurial development. The homeowners must have job skills, and a job in order to support and maintain their homes after they have received them.

The costing model for this project will be developed when the CDC-Gugulethu begins its mass building program. It is not feasible to price the homes now, because inflation and other factors will influence the cost of the homes at the time construction begins. The major building material suppliers have agreed to special bulk pricing schemes for the housing delivery programs sponsored by the South African Housing and Trade and Industry Departments. However, it appears that the local building contractors, and laborers need special attention, since they appear to be unwilling to cooperate price-wise, and this attitude could be disastrous to mass, affordable housing delivery. Additionally, the housing subsidy schemes as administered now, will only pay the builder for the home after it is built. If this policy is not changed, or if bridge financing is not made available, small, minority contractors will not be able to participate in mass housing delivery; again dictating the need to motivate the building contractors and workers to re-evaluate their pricing schemes for RDP housing delivery programs.

ADHERANCE TO GRANT REQUIREMENTS

The following documents the proposed goals and objectives met under this grant.

1. PEER Consultants, PC and PEER Africa developed and provided engineering and planning support services for the construction of two ECOTM structures in Gugulethu. Additionally, the companies also provided all construction management and oversight during the construction period.
2. Because of language differences, all training was done orally. Training materials were prepared for the anticipated management teams that will be provided by the CDC-Gugulethu and the housing committee of the community. These materials were developed based on the building of the two demonstration homes and the Kutlwanong experience. Materials will be updated and expanded when the mass housing delivery initiatives begin. Training materials developed, before and during this period, are given in the final report for USDOE Grant Number DE-FG36-96G010182.
3. PEER Africa participated in Workshops held in August 1996 and February 1997 as part of the BNC meetings to inform US businesses of opportunities in South Africa. At the request of the US Department of Commerce, PEER Africa met with DOW Chemical in South Africa to assist them in the decision-making process of entering the housing market in South Africa. PEER Consultants, and PEER Africa continue to respond to all inquiries from private and public concerns on opportunities in South Africa. The US Departments of Energy, Commerce, and Agency for International Development routinely direct inquiries concerning housing to PEER Africa. These inquiries are handled by Dr. Abron in the United States, and by Mr. Guy in South Africa.
4. In May 1997 the energy efficiency housing work being done in South Africa with support from this grant and the completed grant, DE-FG36-97G010182 was selected as a "No Regrets Case Study". The United States Environmental Protection Agency did the selection under the mandate of the United Nations Framework for Climate Change Convention (UNFCCC). These are projects that demonstrate the ability of developing countries to move forward with their plans of growth and industrialization, and not negatively impact global warming concerns. The work done under this grant and the UNFCCC recognition has demonstrated the need for US renewable energy technologies to be involved in meeting the energy and environmental requirements of foreign countries. Before PEER Africa entered this market in South Africa, there were no US companies or individuals in this market. There are some South African firms working in the area of energy efficiency in housing, but their work has not penetrated the marginalized areas as yet. This is the area where PEER Africa's work has had the greatest impact to date.
5. In August, September, October, and December 1997, Dr. Abron participated in Workshops in Germany, Senegal, Brazil, and Japan, respectively dealing with the results of this project and the impact it has had on housing policy in South Africa. PEER Africa was invited to participate in these workshops by the UNFCCC. The United States Environmental Protection Agency, PEER Consultants, PC, and PEER Africa provided the support for those activities. The exposure at those workshops:

- Ensured US participation in energy related projects in foreign countries and utilization of US energy and housing technologies in foreign countries.
 - Assisted foreign countries in meeting their energy needs through the use of renewable energy in an environmentally acceptable manner consistent with sustainable development policies.
6. The report "Housing As If People Mattered – The Kutlwanong Story" is given as Appendix C to this report. This report documents the UNFCCC recognition. This report fully documents the results of Grant DE-FG36-97GO10182. The visibility given the project being supported in part by this grant resulted in the preparation of the above referenced report. Application was made to the US Initiative on Joint Implementation (USIJI) for inclusion of this project in their portfolio of projects being supported by the United States for compliance with the Climate Change Convention established in Brazil in 1992. The USIJI committee has visited the project in Gugulethu and their response is favorable for acceptance in their program. Recognition by the USIJI will insure the visibility needed to attract US businesses providing technologies and equipment to enhance energy efficiency in building design, and community planning and development. The acceptance letter and press release can be found in Appendix C.

US/RSA Gore-Mbeki Integrated Housing Program

PEER Africa (Pty.) Ltd.
on behalf of the
US Department of Energy
1997

LILIA ABRON, Ph.D., P.E., *PRESIDENT*
DOUGLAS GUY, MBA, *OPERATIONS MANAGER*

IN ASSOCIATION WITH
ASCH CONSULTING ENGINEERS

Gore-Mbeki Integrated Housing Report – *Innovative Building Systems*

USDOE Appropriate Technology Demonstration Units

- The integrated housing program involves the integration of energy and environmental considerations with affordable housing development.
- Involves capacity building, job creation and entrepreneurial development.
- Creates a framework for the introduction of applicable energy related technology to historically disadvantaged communities.

Energy Cost Optimized Housing

Incorporates Passive Solar Housing Design

Problem Statement Status Quo Housing:

- Indoor climate/conditions inside newly built houses and shacks are worse than outdoors
- During winter, 57% heating fuel consumption wasted
- Substandard inadequately small houses built
- 72% of house builders not building thermally efficient housing in South Africa
- Low level of awareness, low-cost housing options not available
- 42% of disposable income of poor spent on energy
- More than 6 400ha of woodland consumed per year
- High wasteful long term running costs
- Billion Rand per year spent on respiratory illness and other health related costs
- Terrible smoky conditions at night and during winter months

USDOE Appropriate Technology Demonstration Units

*Highlights the following: Affordability – Human Comfort –
Lower Energy Costs – Health Environment*

- Northward orientation
- Roof overhang
- Insulation of ceilings and walls
- Mass wall design with outer “skin” of insulation
- Window placement
- Roof design of ventilation
- Roof color
- Natural “low cost” lighting alternatives

USDOE Appropriate Technology Demonstration Units

***Highlights the following: Affordability – Human Comfort –
Lower Energy Costs – Health Environment***

(cont'd)

- Space heating and cooking appliances / low smoke-particulate fuels
- Innovative water heating concepts
- Energy efficient appliances and fixtures
- Water conserving fixtures

ECO™ Housing

Incorporates Passive Solar Housing Design

ECO™ Housing Concept:

- Promotes rapid, acceptable, mass housing delivery
- Establishes a level of service (LOS) for housing comfort
 - Space, climate control, value, comfort, appearance
- Increases household equity / Reduces household operating costs
- Improves environmental conditions
- Promotes SMME development/local job creation
- Creates dialog with major building material suppliers
- Reduce up front costs
 - Bulk purchase of building supplies
 - Negotiations for infrastructure payment
 - Rapid construction methods

ECO™ Housing

Incorporates Passive Solar Housing Design

Key no-cost/low cost steps:

- Northward orientation
- Window placement
- Roof overhang
- Insulated ceilings/walls
- Mass wall option
- Multi-family option
- White painted roof
- Ventilation/Heating Appliances/Low-Smoke Fuel Plan

CASE STUDY 1

The Kutlwanong Project

***Northern Cape Province,
Republic of South Africa (RSA)***

- MoU signed in October 1995
- First demo unit constructed and dedicated in March 1996
- Project-Linked Subsidy approved in November 1996
- Funding for Phase 1 available in December 1996
- Worker training started for 120 unemployed residents
- Project "show-cased" on national television program
- 30 structures under development/80 residents employed
- 200 structures to be completed by early April 1997
- 1000 units to be started in April-May 1997 time frame - Phase 2

Existing Kutlwanong Project

Phase I

CASE STUDY 2

The Gugulethu Township Project

Capetown, Western Cape Province

Republic of South Africa (RSA)

- Two ECO™ structures constructed
 - Mass wall system - using solid concrete wall, outside insulation and plastered surfaces
 - Insulation/steel frame based wall system - Upgraded Kutlwanong house
- Two family unit - Prototype "Courtyard" design
 - Share a common wall
 - 2 bedrooms/bath, kitchen and lounge
 - Open court yard separates living space w/fence adds security
- Single family unit - 2nd generation Kutlwanong house
 - Improved insulation system
 - Modified roof design - Vaulted to improve ventilation
 - 2 bedrooms, bath, kitchen and lounge

Courtyard Design

Sketch & Floor Plan Kutlawong

©1997 PEER Consultants, P.C.

Thermal Comfort: Comparison of Existing to ECO™ Structures

Show charts comparing standard tin shack to Kutlwanong insulated and mass house

Thermal Comfort: Comparison of Existing to ECO™ Structures

Show charts comparing standard tin shack to Kutlwanong insulated and mass house

Cost: Comparison of Existing to ECO™ Structures

Environmental/
Energy Costs

Incremental
Construction Costs

**Worst
Case**

**Lowest
Cost**

**Best
Case**

**Highest
Cost**

Local Industrial Park Concept

ECO™ Building Manufacturing Centres

**Lansdowne Road
Local Industrial Park (LIP)**

Entrepreneurial Development SMME

Bulk Building Materials
Sand-Stone-Brick

Other Tenants

SMME

Jobs

Local
Business
Service
Centre

Jobs

Single Family

ECO™ Industrial Site Demonstration

Community Development

ECO™ Community
Multi-Family Residential
Demonstration

Courtyard
House

Remainder Road

Sites

Local Contractors

- ASCH Consulting Engineers
- Stanley Manong & Associates
- W.J. Matthews & Associates
- Bruce Dundas
- MANYAM (SA) (Pty.) Ltd.

Current Private Sector Sponsors of RDP Housing Program:*

- MANYAM (SA) (Pty.) Ltd.
- SAGEX
- Brick'N Tile
- Alpha Cement
- Gypsum Industries Ltd.
- ISCOR Limited

*Negotiations are underway with other potential sponsors

US/RSA Gore-Mbeki Integrated Housing Program

**PEER Africa (Pty.) Ltd.
on behalf of the
US/RSA Binational Commission
1998**

LILIA ABRON, PH.D., P.E., *PRESIDENT*

DOUGLAS GUY, MBA, *OPERATIONS MANAGER*

IN ASSOCIATION WITH

STANLEY MANONG & ASSOCIATES,
CONSULTING ENGINEERS

ASCH CONSULTING ENGINEERS

IIEC-EUROPE

GUGULETHU CDC

KUTLWANONG CIVIC INTEGRATED HOUSING TRUST

FUNDING PROVIDED BY

U.S. DOE

U.S. AID

PEER CONSULTANTS, P.C.

PEER AFRICA (PTY.) LTD.

Gore-Mbeki Integrated Housing Report – *Innovative Building Systems*

USDOE Appropriate Technology Demonstration Units

- The integrated housing program involves the integration of energy and environmental considerations with affordable housing development.
- Involves capacity building, job creation and entrepreneurial development.
- Creates a framework for the introduction of applicable energy related technology to historically disadvantaged communities.
- Facilitates policy changes for mass delivery of environmentally responsive houses and other structures.

Energy Cost Optimized Housing

Incorporates Passive Solar Housing Design

Problem Statement Status Quo Housing:

- Substandard, inadequately small houses being built
- Energy efficient building not a consideration, 1% are energy efficient
- Indoor climate/conditions inside newly built houses and shacks are worse than outdoors
- During winter, over 50% of heating fuel consumption wasted due to inefficiencies in building construction
- Over 25% of disposable income of poor spent on household energy needs
- More than 6 400ha of woodland consumed per year for space heating and cooking
- Terrible smoky conditions inside and outside during winter months
- South Africa has a carbon monoxide indoor air quality problem
- 1 billion Rand per year spent on respiratory illness and other health related costs
- Energy efficient retrofitting for roof, ceiling, walls and ventilation systems difficult to accomplish and costly

Energy Efficient Technology Demonstration Units

*Highlights the following: Affordability – Human Comfort –
Lower Energy Costs – Healthy Environment*

- Northward orientation and large windows north facing
 - Roof overhang for window shading
 - Insulation of ceilings and walls
 - Insulated mass wall design
 - Appropriate window placement — appropriate distance from roof, sizing, and fewer and smaller windows on east and west walls
 - Window placement to insure cross ventilation
 - Light color reflective roof
 - Enhanced natural indoor lighting to reduce energy usage
 - Additional window shading using vegetation
 - Single/multi-family options
-
-

Energy Efficient Technology Demonstration Units

***Highlights the following: Affordability – Human Comfort –
Lower Energy Costs – Healthy Environment***

(cont'd)

- Energy efficient, safe space heating and cooking appliances / low smoke-particulate, and
clean fuels
- Alternative energy sources — LPG, solar, thermal, photovoltaics
- Energy efficient appliances and fixtures
- Water conserving fixtures
- Periscape landscaping

ECO™ Housing

Incorporates Passive Solar Housing Design

ECO™ Housing Concept:

- Involves community and housing recipients
- Promotes rapid, acceptable, environmentally responsive, mass housing delivery
- Establishes a higher level of service for housing comfort
 - Space, climate control, value, comfort, appearance
- Increased house equity / Reduces household operating costs
- Improves environmental conditions — indoor, outdoor, globally
- Promotes SMME development/local job creation
- Reduces up front costs
 - Bulk purchase of building supplies, thus larger house for less
 - Negotiations for land infrastructure payment — reduces first costs
 - Rapid construction methods — reduced labor costs, more jobs created
- Estimated cost of passive solar elements (insulation, larger windows, roof design, mass walls) ~ R 2000-3000/house

CASE STUDY 1

The Kutlwanong Project

*Northern Cape Province,
Republic of South Africa (RSA)*

- MoU signed in October 1995
- First demo unit constructed and dedicated in March 1996
- Project-Linked Subsidy approved in November 1996
- Funding for Phase 1 available in December 1996
- Kutlwanong Civic Integrated Housing Trust established in August 1997
- USAID training grant for Trust issued August 1997
- Project "show-cased" on national television program
- First street of new homes dedicated May 1997
- 200 structures to be completed by Spring 1998
- 1000 units to be started June 1998 - Phase 2
- Phase 2 will be done through tenders issued and managed by Trust
- Project labeled "No Regret" case study by United Nations and spotlighted at United Nations Framework Convention for Climate Change meeting in Koyoto, Japan in December, 1997

Case Study 1 – Kutlwanong Project

Phase I

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CASE STUDY 2

The Gugulethu Township Project

Capetown, Western Cape Province
Republic of South Africa (RSA)

- Two ECO™ structures constructed
 - Mass wall system - using solid concrete wall, outside insulation and plastered surfaces
 - Insulation/steel frame based wall system - Upgraded Kutlwanong house
- Two family unit - Prototype "Courtyard" design
 - Share a common wall
 - 2 bedrooms/bath, kitchen and lounge
 - Open court yard separates living space w/fence adds security
- Single family unit - 2nd generation Kutlwanong house
 - Improved insulation system
 - Modified roof design - Vaulted to improve ventilation
 - 2 bedrooms, bath, kitchen and lounge

Courtyard Design

Phase I

Capetown Kutlwanong Design

© 1997 PEER Consultants, P.C.

Thermal Comfort: Comparison of Existing to ECO™ Structures

Charts comparing standard tin shack to Kutlwanong and Courtyard model houses.

24 Hour Thermal Comfort Incremental Construction Costs

Worst Case

Lowest Cost

15+ Degrees Difference

8-10 Degrees Difference

Best Case

Highest Cost

Gore-Mbeki Integrated Housing Program

US/RSA Departments of Housing

US/RSA Departments of Energy

US/RSA Departments of Environment

US/RSA Departments of
Commerce and Trade & Industry

RSA Department of Public Works

US/RSA Departments of Transportation

Benefits:

People and Family Oriented Communities

21st Century Innovative Building Systems

Rapid Increase in Acceptable/Affordable
Housing Delivery

Positive Environment, Safety and
Health Effects

Economic Development

SMME Development

Local Jobs

- Energy Inefficient / Substandard Housing
- High Energy Costs
- Utilization of "Dirty" and High Particulate Fuels
- Severe Indoor and Outdoor Air Pollution
- Environmental Safety and Health Issues
- High Respiratory Illnesses
- High Unemployment Rate
- Few Job Skills for Upward Mobility
- Limited SMME Development
- Limited Financing
- Limited R&D

- Development and Implementation of Joint Programs
- Technology Transfer
- Capacity Building
- Demonstration of Innovative Pilot Projects
- Financing Support
- Coordinate Private Investment
- Promotion and Implementation of Labor Intensive/Gender Focus and Training

- Emphasis on People, Environment, Energy, Health, Economy
- Mass Awareness
- Mass Delivery
- Rapid Enhanced Quality of Life
- Avoidance of Technology Dumping
- Implementation of Appropriate State-of-the-Art Technologies and Science
- Training and Jobs Creation
- New Businesses Established

Current Private Sector Supporters of RDP/Binational Commission Integrated Housing Program:

- Cumulus Insulation
- SAGEX
- Brick'N Tile
- Alpha Cement
- Gypsum Industries Ltd.
- Qunta & Ntsebeza Attorneys & Conveyancers
- Cader Brick & Transport
- KMMT Brey & Accountants (Northern Cape) Inc., Chartered Accountants (SA)
- Build-O-Rama
- BIFSA (Trainers)

*Negotiations are underway with other potential sponsors

Concept of the Local Industrial Park

LOCAL INDUSTRIAL PARK

21st CENTURY ENERGY
DEMONSTRATION CC

LANSDOWNE ROAD

U.S. DEPARTMENT OF ENERGY TECHNOLOGY DEMONSTRATION UNIT

Kutiwanong Model:

Sponsored by the Honorable Acting Secretary of Energy Charles
Honorable Hazel O. Leary Former Secretary
Gugulethu R.D.P Forum
Lilia Abron, Ph.D. P.E; President of PEER Africa (PTY) LTD.

INTRODUCED BY:

PEER AFRICA (PTY) LTD- GENERAL CONTRACTOR
Douglas L. Guy, Project Operations Manager

SUB CONSULTANTS:

LONG & ASSOCIATES CC- ENGINEERING CONSULTANT
Manong
Community Development Corporation
Matthews & Associates - Surveyors & Constructors

Suppliers:

Alpha Cement (Pty) Ltd. Bricks

Housing as if People Mattered

The Story of Kutlwanong, South Africa

6 December 1997

A No Regrets Case Study Prepared For:

United Nations Conference of the Parties III

Developed By:

The Community of Kutlwanong, PEER Africa, the Energy for Development Research Centre, and the International Institute for Energy Conservation

Supported By:

Climate Policy and Programs Division of the Office of Policy, Planning and

Housing as if People Mattered: *The Story of Kutlwanong, South Africa*

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Supported by:

Climate Policy and Programs Division of the Office of Policy, Planning and Evaluation
The United States Environmental Protection Agency

6 December 1997

Housing As If People Mattered: Executive Summary

Low-cost energy efficient homes hold the promise to improve health and human comfort, provide local economic opportunities, and address social inequalities while simultaneously achieving greenhouse gas reductions. . .

Introduction

South Africa became a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) in June 1993. After a series of delays, ratification of the Convention by Parliament finally took place on the 29 August 1997. As a non-Annex I country, South Africa has no immediate greenhouse gas (GHG) abatement targets. However, as both the largest source of carbon dioxide in SADC and in Africa (95% and 15% of carbon dioxide emissions respectively) and as a middle-income country with the potential for significant economic growth, South Africa is likely to consider GHG mitigation as an increasingly significant issue (Asamoah & Grobbelar, 1996; van Horen & Simmonds, 1996). With the challenges facing South Africa in the reconstruction and development of its society and economy, it is crucial that any mitigation measures under consideration are in line with national development objectives and complement rather than compromise them.

that not only reduce greenhouse gas emissions, but also make sense from a financial, social or other policy perspective. 'No regrets' approaches allow nations to move forward on greenhouse gas reductions while limiting financial risk and addressing other development and policy goals. South Africa's broad socio-economic goals are detailed in the Reconstruction and Development Programme (RDP) and include the following principles: meeting basic needs, developing South Africa's human resources, building the economy, and democratising the state and society. The RDP covers a wide range of social and economic issues, including job creation, housing delivery, provision of water and sanitation infrastructure, education, access to electricity and affordable health care. Of these programmes, mass housing and electrification are the most high profile and have become the main thrusts of the government's drive toward social equity.

. . . and the children of Kutlwanong will be the primary beneficiaries of PEER Africa's ECO™ House

The mass housing programme presents a remarkable opportunity to introduce energy efficient and environmentally sound measures into the low-cost housing market at the construction phase.

In 1994, the government committed itself to providing housing assistance for one million low-income households in South Africa. Many of these households use high-greenhouse gas emitting fuels such as coal, wood and kerosene to meet their household energy needs. The mass housing programme presents a remarkable opportunity to introduce energy efficient and environmentally sound measures into the low-cost housing market at the construction phase. Introduction of these measures will not only reduce greenhouse gas emissions, but will also have positive impacts on the health, productivity and income of poor households.

This paper explores the costs and benefits of such an example of energy efficient low-cost housing, drawing on the first large-scale, commercial, energy efficient low-cost housing project in South Africa, the Kutlwanong Housing Project. The obstacles to the delivery of energy efficient housing in Kutlwanong and nationally, in South Africa, are discussed and the measures required to achieve scaling-up of the initiative are outlined.

Background

Kutlwanong is a planned informal settlement of approximately 2,300 families (8,000 residents) located near the city of Kimberly in the Northern Cape Province of South Africa. The settlement was formally established in 1994. One year later, in response to the government mass housing programme, the community sought to gain access to formal housing. PEER Africa, a

civil and environmental engineering firm, became involved in Kutlwanong as a direct result of the United States-South Africa Binational Commission (BNC). In 1995, the US Department of Energy sent a delegation to South Africa as part of the BNC. The delegation held a workshop with local and national energy officials in Kimberly. PEER Africa invited the leaders of Kutlwanong to attend the workshop and to determine whether they would be interested in participating in projects resulting from the meetings. The community leaders were interested in the concept of combining energy efficiency with housing put forward by PEER Africa. At the conclusion of the workshop, a Memorandum of Understanding (MOU) to develop and implement this housing concept was signed by the Kutlwanong community, PEER Africa, the Northern Cape Provincial Housing Department, the US Department of Energy, and the South African Department of Minerals and Energy.

The process employed by PEER Africa in Kutlwanong has been a participative one, working with the community to develop a framework which meets their development needs. The house style was developed through a participative process involving frequent community discussions/workshops to explain the concept of passive thermal design. The community's opinion was also solicited to establish their standard for an acceptable living space and their preferences for layout and design. The technical input to the design from a thermal efficiency perspective was provided by PEER Africa in consultation

The ECO™ house is designed not only to improve thermal performance and reduce energy consumption for space-heating (thus reducing levels of indoor air pollution), but also to provide outlet vents for noxious fumes from coal stoves.

PEER Africa are already committed to building a further 5,000 subsidy units over the next two years . . .

indoor air pollution exceeded World Health Organisation households in South Africa found that people's exposure to indoor air pollution exceeded World Health Organisation maximum safe exposure guidelines by a factor of two to three in summer and six to seven in winter.

Kerosene use also creates extremely hazardous conditions in the home. Accidental fires and burns and poisonings from kerosene ingestion are a common occurrence in South Africa, resulting in illness, injuries, loss of property and even death.

The ECO™ house is designed not only to improve thermal performance and reduce energy consumption for space-heating (thus reducing levels of indoor air pollution), but also to provide outlet vents for noxious fumes from coal stoves. Furthermore, the ECO™ house is constructed of materials that do not readily burn thereby reducing the risk of fires.

Community empowerment

The Kutlwanong housing project is a self-help community development programme which is managed by the people of Kutlwanong through their community leaders. The community has strong leaders who have further developed their leadership and negotiation skills through interactions with a wide range of stakeholders in the implementation of the housing project. PEER Africa provides direct management, hands on training and development guidance to the leaders. The community leaders are beginning to market their newly acquired negotiating

skills and knowledge with other communities.

Employment benefits

The housing project has provided paid employment for residents of the Kutlwanong community. Over 120 community members (10% women) are presently employed as builders on the project and are receiving on-the-job skills training. Individual community members are looking forward to using the skills they have learned from the project for life-long employment. In addition, a Local Industrial Park / business zone is planned for future development close to Kutlwanong and is expected to provide a source of employment to the community.

Benefits to the suppliers

In an effort to reduce the costs of building materials, PEER Africa, together with the Kutlwanong community leaders, sought innovative contractual arrangements for bulk purchasing of building materials for the home with large and small materials suppliers. These suppliers benefit from the bulk procurement by achieving discounts from their sources, and can then recoup their perceived profit losses on the Kutlwanong project by achieving wider profit margins on other projects.

Recommendations

PEER Africa are already committed to building a further 5,000 subsidy units over the next two years and are planning to expand their operations in South Africa through a franchise operation of the ECO™ home. To

this end, PEER Africa are involved in a number of initiatives to facilitate the replication of the Kutlwanong Housing Project. These include:

- PEER Africa and the South African DTI are establishing master purchase agreements with a network of building suppliers throughout the country;
- PEER Africa is working with several banks and NURCHA to develop a plan to provide financing sources and partnerships;
- PEER Africa is providing status reports and presentations to South African government officials about progress and government obstacles in the way of scale-up; and
- The construction of demonstration homes in small communities in key climatic zones of South Africa is being pursued as a mechanism to increase awareness in communities, municipalities and national government.

In order to ensure that energy efficient housing is implemented at scale, however, it is essential that developers in South Africa learn from each others' experiences. The critical success factors which are key to the Kutlwanong PEER Africa ECO™ Housing and community development project are:

- the implementation of a community development framework to obtain and sustain community acceptance of the project;

- securing the interest (and support) of provincial and local government officials who are responsible for the implementation of housing delivery;
- knowledgeable and respected community leaders or facilitators to drive the process at the grass roots level;
- the development of the local economy to ensure that the project does not result in a barren residential environment with no opportunities; and
- the need for bridge financing and operating capital for emerging firms who are unable to access credit through traditional finance channels.

The Kutlwanong project is in a unique position to shift the housing paradigm in South Africa, and prove that low-cost homes do not necessarily mean low quality. The lessons of the Kutlwanong project should extend well beyond the borders of South Africa. The project demonstrates that cost-effective, no-regrets solutions to global climate change do exist. Low-cost energy efficient homes hold the promise to improve health and human comfort, provide local economic opportunities, and address social inequalities while simultaneously achieving greenhouse gas reductions.

In order to ensure that energy efficient housing is implemented at scale, it is essential that developers in South Africa learn from each others' experiences.

The Kutlwanong project is in a unique position to shift the housing paradigm in South Africa . . .

The project demonstrates that cost-effective, no-regrets solutions to global climate change do exist.

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1. Background—National Energy and Housing Issues

1.1 Introduction

South Africa's road to democracy has been a long political struggle fought over 40 years of apartheid rule. The heralding of the transition was marked by the termination of a thirty-year ban on the African National Congress (ANC) and the Pan African Congress (PAC) on the 2 February 1990 and the release of Nelson Mandela nine days later (O'Meara, 1996). Four years of negotiations came to fruition when South Africa held its first elections on the 27-29 April 1994 and Nelson Mandela was inaugurated as the first democratic President of South Africa on the 10 May 1994. The newly-elected government inherited from the apartheid regime a country beset with social inequities, economic stagnation and environmental degradation. The burdens of these problems bear the heaviest on the poor.

The new ANC-majority government, has the responsibility of bringing the South African national policy in line with the goals of the ANC and the new South African Constitution. The broad socio-economic goals of the ANC are detailed in the Reconstruction and Development Programme (RDP) and include the following principles: meeting basic needs, developing South Africa's human resources, building the economy, and democratising the state and society. It is appropriate that environmental policy in South Africa focus on those environmental issues that converge with South Africa's development objectives. This background section aims to give a brief overview of South Africa; its demographics, development and environmental imperatives, its energy sector, and its major policy concerns.

1.2 National background

Located at the southern tip of Africa, South Africa covers an area of 1 223 200 square kilometres (or 4% of Africa's land), accommodating approximately 40 million people (7% of Africa's population) at a density of 33 persons per square kilometre (Figure 1-1) (IEA, 1996).

Figure 1-1. The Nine Provinces of South Africa

Note: Kutlwanong, the case study community, is marked in the Northern Cape Province

Approximately two-thirds of South Africa's population reside in the provinces of Kwazulu/Natal, Gauteng, Eastern Cape and the Northern Province. The rural/urban distribution between provinces is skewed, with the Western Cape and Gauteng having more people re-

siding in urban areas while the Eastern Cape, KwaZulu/Natal and the Northern Province are predominantly rural (see Table 1-1).

Table 1-1. Population distribution and poverty by province in South Africa

Provinces	Total population		Rural population		Urban population		Poverty
	10 ⁶	% of total SA pop.	10 ⁶	% of total SA pop.	10 ⁶	% of total SA pop.	% families in poverty
Western Cape	3.4	9.0	0.5	1.3	2.9	7.7	23
Northern Cape ^a	0.7	1.9	0.2	0.5	0.5	1.3	57
Eastern Cape	6.2	16.4	4.2	11.0	2.0	5.3	78
Free State	2.6	6.9	1.2	3.2	1.4	3.7	66
KwaZulu/Natal	7.9	20.9	4.9	13.0	3.0	7.9	53
Gauteng	6.5	17.2	0.3	0.8	6.2	16.4	19
North West	3.1	8.2	2.1	5.6	1.0	2.6	57
Mpumalanga	2.7	7.1	1.9	5.0	0.8	2.1	52
Northern Province	4.7	12.4	4.3	11.4	0.4	1.1	77
Total	37.8	100	19.6	51.9	18.2	48.1	52.8

^aNorthern Cape is the province where Kutlwanong is located. Source: Simmonds & Mammon, 1996

Table 1-1 shows the relative poverty levels in South Africa, where poor is defined as those families earning less than R301 (US\$66.9) per month per adult. This cut-off point was used because it results in a level of poverty in the same range as minimum food intake indicators (SALDRU, 1995). According to this definition approximately 53% of the South African population can be classified as poor. Analysis of the distribution of poverty between rural and urban areas shows that, on average, rural areas in South Africa have a poverty rate of 73.7% and urban areas have a poverty rate of 28.8%. As a result of apartheid practices, the burden of poverty in South Africa is also racially skewed. Sixty-five percent (65%) of Africans reside in the poorest 40% of households in South Africa, accounting for 95% of South Africa's poor. In contrast, only 0.7% of South Africa's white population fall into this category, accounting for only 0.1% of the country's poor (SALDRU, 1995).

The World Bank has classified South Africa as an upper-middle income economy (see Table 1-2). However, socio-economic comparisons of South Africa and the average for upper-middle income economies show that South Africa falls into the lower end of this category (Scholand, 1997).

Table 1-2. Selected socio-economic indicators, 1993 ➤

Countries	Inflation (1980-93)	Literacy (%)	Life expectancy (years)	Infant mortality (per 1000 births)
<i>High income economies</i>				
United States	3.8	^a	76	9
Japan	1.5	^a	80	4
Germany	2.8	^a	76	6
United Kingdom	5.6	^a	76	7
<i>Middle-income economies</i>				
South Africa	14.7	62.4	63	52
Mexico	57.9	87	71	35
Greece	17.3	93	78	10
South Korea	6.3	^a	71	11
<i>sub-Saharan Africa</i>	16.1	50	52	93

^aLiteracy has been estimated as more than 95% in these countries. Source: World Bank, 1995.

Another method of comparing levels of development across nations is to use a measure called the Human Development Index (HDI). The HDI is calculated by the United Nations Development Programme and is based on three indicators: literacy, life expectancy and income (DBSA, 1994). Countries rated at less than 0.5 are deemed to be at a low level of development. Countries rated between 0.5 and 0.8 are considered to be at a medium level of development, while those between 0.8 and 1.0 are said to be at a high level of human development (Scholand, 1997).

Table 1-3. HDI for South Africa, its former racial categories & selected countries, 1992

HDI Ranking	Country	HDI
1	Canada	0.950
2	USA	0.937
22	Greece	0.907
	<i>South African Whites</i>	0.906
24	Hong Kong	0.904
56	Qatar	0.837
	<i>South African Asians</i>	0.836
57	Colombia	0.836
94	Uzbekistan	0.706
95	South Africa	0.705
101	Lebanon	0.675
	<i>South African Coloureds</i>	0.663
102	Samoa (Western)	0.651
127	Cameroon	0.503
	<i>South African Blacks</i>	0.500
128	Pakistan	0.483

Source: Scholand, 1997

South Africa's level of development varies both racially (as indicated in Table 1-3) and regionally. The provinces of the Eastern Cape and the Northern Province score below 0.5 while the Western Cape scores the highest with 0.76 (DBSA, 1994).

Figures for levels of unemployment vary substantially according to how socio-economic indicators are defined. The Central Statistical Services (CSS) defines unemployed as those with a desire to work, whether having taken active steps to seek employment or not. The CSS estimates the national level of unemployment to be 29%. The racially skewed nature of unemployment in South Africa serves as another testament to the social impact of apartheid. Thirty-seven percent of the African population were estimated to be unemployed in 1994, compared with approximately 24% of the 'coloured' population, 16.3% of the Asian population, and only 8.5% of the white population (DBSA, 1994). Note that these figures do not adjust for underemployment and, therefore, they present conservative (low) estimates of the actual levels of unemployment in South Africa. Table 1-4 shows that only 50% of South Africa's economically active population are formally employed.

Table 1-4. Sectoral distribution of the South African labour force (1991)

Sectoral Grouping	Number	Percentage (%)
<i>Total labour force^a</i>	15 814 896	100
<i>Formal employment^b</i>	7 911 401	50
<i>Unemployment^c</i>	2 516 853	16
<i>Informal sector^d</i>	2 516 187	16
<i>Marginal sector^e</i>	2 870 455	18

^aIncludes the economically active section of the population. ^bIncludes persons in paid employment in the formal sector of the economy. ^cIncludes persons who are actively looking for a job, but who are not in any type of paid employment. ^dIncludes all persons active in unregistered enterprises. ^eIncludes all persons in the subsistence agriculture sector and those active in non-market activities which contribute to the family's ability to produce goods and services. Source: DBSA, 1994.

The CSS has estimated South Africa's real economic growth, as measured by Gross Domestic Product (GDP) at constant 1990 prices, to have been 2.8% in 1995, representing part of an upward trend from 1993 (see Table 1-5).

Table 1-5. GDP at factor cost and at constant 1990 prices

Year	GDP (million Rand)	% increase or (decrease)
1988	243 225	3.7
1989	249 192	2.4
1990	247 315	(0.7)
1991	244 549	(1.1)
1992	238 711	(2.4)
1993	267 257	1.6
1994	270 702	2.5
1995	287 233	2.8

Source: CSS, 1994.

The current annual GDP growth trajectory of approximately 3% is insufficient to reverse the trend toward higher unemployment in South Africa. Further, this growth rate will neither provide the necessary resources to expand social service delivery nor allow for an improvement in the national distribution of wealth (Ministry of Finance, 1996). To address this problem, the government has adopted a macro-economic strategy called 'Growth, Employment And Redistribution' (GEAR). The GEAR programme aims to achieve a GDP growth rate of 6% by the year 2000.

1.3 South Africa's GHG emissions

A study of the greenhouse gas (GHG) emissions for South Africa was produced in 1995 (Scholes and van der Merwe, 1995). This study found that in 1988 South Africa was responsible for 1.4% of global carbon dioxide emissions and 1.2% of total global GHG emissions. Carbon dioxide (CO₂) and methane (CH₄) were found to account for nearly 100% of this contribution.

Table 1-6. South Africa's contribution of GHG emissions in 1988

Gas	SA Emissions (Tg/y)	Global emission (Tg/y)	SA as a % of global emissions	Gas Warming Potential	CO ₂ equivalent (Tg/y)
Carbon dioxide (CO ₂)	350	26,000	1.4%	1	350
Methane (CH ₄)	2.84	300	0.95%	64	182
Nitrous oxide (NO _x)	0.00523	4	0.13%	270	1

Source: Scholes & van der Merwe, 1995

Although South Africa's emissions of GHG may seem small in absolute terms, in relative terms they are not. In 1992, South Africa was responsible for 15% of Africa's CO₂ emissions and 11% of its CH₄ emissions (Subak *et al.*, 1992). On a global scale, South Africa was the eighteenth largest emitter of CO₂ in the world, larger than some of the Annex I countries, such as the Netherlands, Turkey and Australia. On a per capita basis, South Africa's carbon dioxide emissions were just under 10 tons per annum, well above the global average of over 4 tons per person and the African average of just over 2.5 tons per person (Subak *et al.*, 1992; World Bank, 1994). When South Africa's CO₂ emissions are expressed in terms of economic output, it becomes evident that South Africa is a very carbon intensive economy, producing US \$259 of measured economic output for every ton of CO₂ emitted. This is a higher CO₂ emission rate per unit of GDP than some developing countries listed in Table 1-7 by a factor of 1.6 to 4. Compared to some high income countries, South Africa's economy fares 4 to 11 times as carbon intensive.

Table 1-7. Emissions in selected countries in 1990, in relation to population and GDP

Country	CO ₂ emissions (Mt/year)	CO ₂ per capita (t/year)	US\$ of GDP per ton of CO ₂
High-income countries			
United States	4,569	18.3	1,180
Japan	1,005	8.1	2,928
Germany	990	12.5	1,503
UK	564	9.8	1,729
Netherlands	180	12.1	1,551
Middle-income developing countries			
Brazil	990	6.6	418
Mexico	491	5.7	484
South Korea	209	4.9	1,131
Greece	73	7.2	793
South Africa	350	9.7	259

Note: the calculation of GDP used a 1991 exchange rate of R3.67 to US\$1. The current rate is R4.5 to US\$1.
Sources: Subak et al., 1992, World Bank, 1994, Scholes & van der Merwe, 1995 in van Horen & Simmonds, 1996

In 1995, South Africa produced a business-as-usual scenario for the Berlin Climate Conference. Projections from this scenario for the period 1995-2015 included the following:

- Overall greenhouse gas emissions will increase over this period at approximately 3% per annum;
- CO₂ emissions to increase from 350 million tonnes in 1988 to 600 million tonnes in 2015;
- Methane emissions overall will increase by more than 50% over current levels; and
- Methane emissions from coal mining will increase by approximately 67% (IEA, 1996).

It is expected that CO₂ production from land-use change will decline over the next 50 years as approximately 90% of South Africa's arable land has already been utilised. However, the overall trend in CO₂ emissions is expected to match the rate of increase of GDP, unless control measures are introduced (Scholes and van der Merwe, 1996).

In 1988, the energy sector accounted for 97.4% of CO₂ emissions and approximately 57% of South Africa's methane emissions. If the global warming potentials of these methane and carbon dioxide emissions are combined, the energy sector can be said to be responsible for about 74% of the country's contribution to climate change (van Horen & Simmonds, 1996). As the energy sector is the major contributor to emissions of CO₂ and CH₄ in South Africa, it is clear that mitigation strategies in South Africa should focus on this sector.

1.4 Background to national energy system

1.4.1 National energy policy

During the apartheid era, energy policy was governed primarily by the desire for greater energy security. The white minority government, facing international sanctions and an oil em-

bargo, spent billions of Rand building synthetic petroleum fuel plants and nuclear generation capacity. The energy sector during this period was governed by secrecy, which resulted in a lack of energy data that could have allowed rational, balanced energy policies to develop.

In the absence of a national energy strategy, the newly elected government commenced the development of a national energy policy based on input from the energy demand and supply sectors. In 1995, the Department of Minerals and Energy published an energy policy discussion document which was debated and discussed with stakeholders from across South Africa at the National Energy Policy Summit in November 1995. Over one hundred representatives from the formerly marginalised communities attended and participated in the Summit. These people had attended workshops organised by a number of South African organisations such as the Energy and Development Group, the Energy for Development Research Centre, and the Women's Energy Group, enabling them to partake in the policy formulation process and offer a perspective not voiced before in South Africa. The Summit and all the input has culminated in the drafting of an energy White Paper, which as of November 1997 has yet to be finalised and become official state policy. The cornerstones of the draft energy policy are to:

- Improve social equity by addressing the energy requirements of the poor;
- Enhance efficiency and competitiveness of the South African economy by providing low-cost and high quality energy inputs to industrial, mining and other sectors within restructured and appropriately governed energy markets; and
- Work toward environmental sustainability by addressing both short-term environmental problems and planning for a long-term transition toward sources of energy with minimum environmental impacts' (DME, 1996).

1.4.2 National energy use

Analysis of South Africa's primary energy consumption by supply sector shows that most of South Africa's energy is derived from coal (see Figure 1-2).

Figure 1-2. Primary energy consumption by supply sector

Source: Eberhard & Trollip, 1994

Approximately 57% of the coal use is for electricity generation, and about 22% is used to produce liquid fuels (see Figure 1-3). The heavy dependence of the South African economy

on coal, and specifically in these two sub-sectors, is significant for policy solutions to energy and environmental problems in South Africa.

Figure 1-3. Total coal use in various sub-sectors, 1990

Source: Eberhard & Trollip, 1994

In the demand sectors, industrial and commercial activities account for almost half of South Africa's energy consumption (Figure 1-4). A comparison of the specific energy consumption of South African industry with other developing and developed countries shows South African industry to be relatively energy inefficient. For example, the Energy Research Institute has identified a potential for energy efficiency improvements of between 20 and 40% in the industrial sector.

The transport sector is the second highest energy consumer group in South Africa, accounting for 24% of net energy consumption, of which 88% can be attributed to road transport. Apartheid land-use planning has resulted in sprawling, low-density cities with long trip lengths. Mass housing can be used to densify cities, thereby reducing trip lengths and providing the necessary thresholds for viable public transport systems. Furthermore, significant potential exists for vehicle efficiency improvements as the current vehicle stock is relatively old and comparatively less efficient.

Figure 1-4. Net energy consumption by major consumer groups, 1989

Source: Eberhard & Trollip, 1994

The household sector is the third largest consumption group in South Africa. Analysis of energy consumption by fuel type in the residential sector demonstrates that large variations exist in the type and combinations of fuels used to meet household energy needs. Due to

their historically privileged position, most white South African's have access to electricity and use it as their main source of energy. Black South African households use a wider range of energy carriers to meet their energy needs. The energy consumption patterns in these households are influenced primarily by cost, access, location, and climatic conditions.

By the end of 1996, approximately 55% of all South African households had access to electricity. The proportion of households connected to the electric power grid varies from region to region, with a greater proportion being in urban areas. Approximately 79% of all urban households were connected to the electric power grid, while just 27% of rural households had access (NER, 1996).

Low-income, primarily black South African households use a wide range of fuels to meet their energy needs; this is true even for those households connected to the electric power grid. These fuels include wood, coal, kerosene, candles, gas, and car batteries. Even though an increasing number of low-income households are gaining access to electricity, their electric power consumption is low, averaging between 80 to 150kWh per month (Davis & Horvei, 1995).

Research has shown that between 80 and 100% of rural, low-income households in areas surveyed use fuel-wood to meet their energy requirements, as opposed to an average of 40% of households in urban areas. These households also supplement their use of fuel-wood with kerosene for heating and cooking, and candles for lighting. Figure 1-5 provides an illustration of the percentages of low-income, rural households using a mix of various energy carriers. For example, a sampled household might use wood, kerosene and candles to meet their energy needs.

Figure 1-5. Percentage of low-income rural households using different energy carriers

Note: this figure shows the range of energy carriers used by low-income households, the bars do not illustrate quantities consumed, but rather the range of fuels utilised. Source: Davis & Ward, 1995.

Liquid petroleum gas (LPG) has a small market share because there is no established distribution chain and due to a price control mechanism, is not competitively priced. Under the current Energy Policy, LPG is regarded as a liquid fuel and is linked to the fixed price of petrol. If LPG were priced at world market levels, it could be one of the cheapest household energy options per unit of useful heat delivered. LPG has other environmental benefits, including the fact that it is a clean, no-smoke fuel and has a lower carbon content per MJ output than coal.

Figure 1-6. Percentage of urban low-income households using selected fuel carriers

Source: Trollip, 1993

Due to its heavy and bulky nature, the price of coal is influenced by transport and handling costs. The greater the distance from a coal mine, the higher the price. As a result, coal's most widespread domestic use occurs in the vicinity of the coal mines (Figure 1-6). Thus, 69% of households in Gauteng and the Free State, which are near to the coal fields, use coal, compared with only 4% of households in the Western Cape and 1% in the Eastern Cape, which are far from the coal fields (Eberhard & van Horen, 1996).

Figure 1-7. South African climatic zones and coal fields

Source: Williams, 1994

Climatic conditions vary widely across South Africa. Figure 1-7 summarises the national climatic picture in six broad climatic zones. These variations in climatic conditions impact significantly on household energy use patterns, particularly the need for space heating. Table 1-8 compares the average monthly energy consumption in four regions of South Africa. Energy use in the colder area of Gauteng is considerably higher than in the temperate areas of Port Elizabeth and Cape Town and the subtropical area of Durban. The variation between

households is partly a reflection of local climatic conditions and partly due to the different fuels used, their costs and the efficiencies of the appliances (Eberhard & van Horen, 1995).

Table 1-8. Average Monthly household energy consumption (in delivered MJ)

Region / City in South Africa	Formal electrified	Formal non- electrified	Planned informal	Unplanned informal
Gauteng	3,358	5,457	5,668	4,199
Durban & Pietermaritzburg	1,935	3,156	2,665	2,069
Cape Town	1,942	1,561	1,461	1,392
Port Elizabeth & East London	1,252	1,098	1,007	1,013

Note: Energy consumption is presented in terms of housing types. Formal housing refers to fixed structures, usually of blocks or bricks, conforming to building codes and situated within declared 'township' areas. Informal housing refers to structures of a less permanent nature which may be in declared or undeclared 'township' areas. Informal housing is further distinguished between those shacks that are on planned sites and those that are not (generally a result of 'land invasions'). Source: Eberhard & van Horen, 1995.

1.4.3 Energy prices

South Africa has the second cheapest kilowatt charge for electricity in the world. Annual price changes have been negative in real terms for several years, with real prices decreasing by 14% between 1987 and 1991 and by an additional 20% between 1992 and 1996. Eskom, the parastatal electric utility, has committed itself to decreasing real prices of electricity by a further 15% between 1996 and 2000, and looks on target to achieve this (van Horen, 1996).

However, from the end-user perspective, the electricity distribution sector is more complex, with over 1000 different tariff rates which vary by up to 230% (Praetorius *et al.*, 1996). While the electricity may be cheap from a global perspective, low-income households with access to electricity generally continue to have low rates of consumption. The low usage rates occur for a number of reasons, two of which include the comparatively higher price of electricity relative to other fuels, and with the additional cost of electric appliances. Table 1-9 presents the actual and relative prices for a range of different fuels used in low-income households.

Table 1-9. Price range of household fuels

Fuel type	Unit	Price range (R/unit)	Comparative price (R/kWh)
Electricity	kWh	0.20 - 0.27	0.20 - 0.27
Candles	candle	0.35 - 0.65	0.36 - 0.68
Kerosene	litre	1.04 - 2.02	0.10 - 0.20
Coal	kg	0.23 - 0.55	0.03 - 0.07
Gas	kg	1.66 - 4.89	0.12 - 0.36
Car batteries	charge	4.65 - 6.26	12.91 - 17.39
Wood	kg	0.00 - 1.46	0.00 - 0.31

Source: Simmonds & Mammon, 1996

1.4.4 Energy expenditure and household budgets

The lower the household income, the greater the proportion of income spent on energy. For example, a study evaluating income and energy expenditure conducted in several 'town-

ships' found that households with monthly incomes over R1,000 (US\$222.2) spend 7% to 11% of their income on energy, while those earning less than R1,000 per month, spend 11% to 21%. And, households earning less than R400 (US\$88.9) per month were found to spend an average of 28% of their income on energy (Eberhard and van Horen 1995). Another study looking at income and energy issues evaluated urban households. This study found that for the high income groups in South Africa, energy expenditure averaged 4% of income, while the low-income households spent 10-12% (Simmonds and Mammon, 1996).

1.5 National politics and environmental policy

Prior to 1993, the nature conservation movement dominated South African environmental debates (Cooper 1993). South Africa's new environmental policy has, however, widened its scope to encompass rural and urban environmental problems arising from the political-economy of apartheid. South African environmental policy thus recognises that while global environmental issues, such as ozone depletion and the enhanced greenhouse effect are pressing environmental concerns, poverty that manifests itself in the form of local environmental issues, including rural and urban land degradation and poor quality of life, are more immediate environmental concerns facing South Africa (Vogel & Drummond, 1995).

1.5.1 South Africa and the UNFCCC: The road to ratification

South Africa became a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) in June 1993. For several reasons – including South Africa's domestic focus preceding and following the country's first democratic elections in April 1994, and the need for a participatory process of consultation with regard to the development of climate change policy – ratification of the Convention was considerably delayed. Parliament successfully ratified the UNFCCC on the 29 August 1997.

Administration of the UNFCCC is the responsibility of the Department of Environmental Affairs and Tourism (DEAT). In mid-1996, the DEAT established the National Committee on Climate Change (NCCC) to advise the Minister of the DEAT on national issues around climate change and to assist as a communication channel between the DEAT and key stakeholder groups related to the climate change issue. The NCCC is a non-exclusive committee, including representatives from central and provincial government, non-governmental and community-based organisations, business and industry, labour and the research community. Specific roles of the NCCC at present are:

- To communicate key events and the policy development process to interested and affected parties through the publication and distribution of a newsletter;
- To develop a national position on climate change issues by:
 - ⇒ Drafting of a discussion document on climate change policy,
 - ⇒ Publicising and fostering debate and consultation on the discussion document through the holding of regional and provincial workshops in which interested groups will be invited to participate, and
 - ⇒ Drafting of a White Paper on climate change.

Several working groups have been set up as sub-committees of the NCCC to target these specific issues related to the formulating, implementing and communicating climate change policy. In addition to these roles, the NCCC oversees the South African Country Studies Programme and the development of a national position on Activities Implemented Jointly/Joint Implementation (AIJ/JI) for the DEAT, as well as acting as an interim clearing house for the evaluation and acceptance of pilot phase AIJ projects.

1.5.2 South African Country Studies Programme

The SA Country Studies Programme (CSP) is funded jointly by the United States Country Studies Programme, the DEAT and the Foundation for Research and Development (FRD). The Programme is co-ordinated and administered by the DEAT and FRD respectively. The broad objectives of the CSP are to provide South African policy-makers with the information they need to make informed and timely decisions with respect to climate change policy. These must be achieved within the context of South Africa's development needs, specifically as articulated in the RDP (DEAT, 1996). The studies should not compete with human or financial resources, but complement development actions.

The three primary objectives of the CSP are:

- To conduct an emissions inventory;
- To collate studies on climate change vulnerability assessments of the natural environment, society and key sectors of the South African economy; and
- To analyse and evaluate options to mitigate net emissions of greenhouse gases and/or adapt to a changing climate.

1.5.3 Activities Implemented Jointly

The AIJ/JI working group of the NCCC has developed and approved a draft national position on AIJ, which expresses South Africa's support for the concept of AIJ for a defined, finite period and its willingness to participate within the AIJ pilot phase. Acceptance of AIJ pilot projects is subject to the following conditions:

- Projects must contribute to national development programmes and be synchronised with such programmes;
- Evaluation of AIJ projects, reporting of agreements and monitoring of performance must be transparent;
- Projects must contribute to the UNFCCC objective of bringing about in a cost-effective manner real, measurable and long-term environmental benefits related to the mitigation of climate change that would not have occurred in the absence of such activities;
- Methodologies of evaluation must be carefully selected so as to ensure the effective measurement of global benefits and total and incremental costs; and
- Funding for AIJ projects must be additional to all existing funding and technology transfer.

It is anticipated that experience gained in the AIJ pilot phase will be used to formulate a South African position on Joint Implementation.

1.5.4 South Africa's major development strategies

In 1994, the ANC put forward the Reconstruction and Development Programme (RDP) as their election manifesto. Following the 1994 elections, the RDP was adopted by the new ANC-dominated government as South Africa's national socio-economic policy framework. The RDP addresses a wide range of social and economic issues, including land redistribution, job creation, housing delivery, provision of water and sanitation infrastructure, education, access to electricity, telecommunications, transport, nutrition, affordable health care, and social welfare.

Of these programmes, mass housing and electrification are the most high profile and have become the main thrusts of the government's drive toward to social equity.

1.5.4.1 Electrification in South Africa

Electricity generation in South Africa is dominated by Eskom, a state-owned utility. In 1995, Eskom accounted for 97% of the electricity sales. Eskom owns, operates and maintains the transmission grid and is thus a de facto monopolist of both the generation and the transmission level. In contrast, the Electricity Distribution Industry (EDI) is highly fragmented. At present, there are almost 400 separate distributors, more than half of which have less than 5,000 customers (Praetorius *et al.*, 1996).

In 1991, under the leadership of Eskom, the Electricity Supply Industry (ESI) embarked on a national programme of electrification (NER, 1995). In 1994, the newly elected Government of National Unity formalised this commitment, embarking on an official policy of electrification as a means of social and economic upliftment of the previously marginalised communities. The RDP target for electrification set by the government is 450,000 connections per annum. Eskom is responsible for 300,000 connections per annum and the EDI is responsible for the remainder. Commencing in 1994, the national electrification programme aimed to provide 2,5 million houses with electricity by the year 2000, thereby increasing the level of access to electricity from 36% to approximately 72% of all households (ANC, 1994). The ESI, as part of the public sector, bears the responsibility for the electrification programme. Between 1991 and 1997, just over 2 million connections were made, increasing the level of access to electricity to approximately 55% of all South African households (NER, 1996).

The RDP cited specifically the need for the electrification of all schools and clinics using both grid and non-grid power sources. This was the result of a 1994 finding that over 4,000 clinics and 19,000 schools, mainly in the rural areas, were not connected to the grid (ANC, 1994). Eskom is at present attempting to electrify all rural schools over a period of five years, by which time all schools should have a basic power supply. In a parallel programme, the Independent Development Trust is undertaking a similar programme for the off-grid electrification of 2,500 rural clinics (IEA, 1996).

1.5.4.2 Low-cost housing in South Africa

Apartheid policies have resulted in a severe housing shortage, specifically in the low-income residential sector. In 1993, the housing backlog was estimated to be as high as three million units (Lupton and Murphy, 1995). In addition, the demand for housing has been estimated as growing at a rate of 200,000 units per annum (ANC, 1994).

The government, under the auspices of the RDP, is working through its Department of Housing to try and alleviate the pressures of this housing crisis. The Department has a goal of providing 1,000,000 housing opportunities by the end of 1999. These "opportunities" take the form of subsidies of varying levels depending on income (see Table 1-10) which contribute toward the costs of the land, services and house. The capital subsidy provides housing assistance to first-time home-buyers who are married or with dependants, have an income of less than R3,500 (US\$778) per month, have not derived benefits from any current or previous housing subsidy scheme, and where the product price does not exceed R65,000 (US\$14,444) (DOH, 1995). The subsidy operates on a sliding scale linked to monthly household income, with a R15,000 (US\$3,333) subsidy being allocated to those who are unemployed or earn less than R800 (US\$178) per month.

Table 1-10. Housing Subsidy Breakdown

Monthly Income Category	Subsidy	Total% Of Households	Cumulative% Of Households
R0 - R800	R15,000	39.7%	39.7%
R801 - R1,500	R12,500	29.0%	68.7%
R1,501 - R2,500	R9,500	11.8%	80.5%
R2,501 - R3,500	R5,000	5.6%	86.1%

Note: For areas where significant land or services upgrading is required, a subsidy of R17,500 (US\$3,889) may be granted. Source: DOH, 1995; NHF, 1996.

It is recognised that the subsidy is inadequate to meet total housing costs, but national housing policy is based on a principle of "width" rather than "depth", aiming to provide a little assistance to as wide a base as possible, rather than more assistance to a few. The structure of the subsidy is based on the premise that households earning more than R800 (US\$178) per month will be able to make some contribution to the cost of their house through securing loans, saving in advance or providing their own labour. An income level of R1,500 (US\$333.3) per month is generally taken as the lower limit for access to retail mortgage finance. Therefore, the quality of the house provided to those families earning less than R1,500 per month (approximately 70% of all South African households) is strongly influenced by the level of subsidy.

The current implementation policy provides an option for the local municipality to deduct their costs for developing the infrastructure in a formerly marginalised community from the housing subsidy. It has been found that some municipalities take up to 75% of the housing subsidy, leaving little resources for the top structure (Eland *et al.*, 1997). In this way, considerable constraints are placed on the size and quality of the home while the RDP housing policy creates a great deal of revenue for local municipalities. The practice of charging these communities upfront for their infrastructure contrasts with the standard approach utilised in established housing areas where the municipality recovers its investment over several years through taxes and usage fees.

Where a municipality has taken a large portion of the subsidy for the provision of infrastructure, the house provided with the remaining money is only a marginal improvement over the existing shack. There is no increase in floor space, and several rooms are combined into one. The house may or may not have an indoor toilet, and almost certainly won't have internal divisions or finishes. These houses are based on the principle of incremental addition, meaning the family will add to its structure as and when funds become available.

Energy efficiency is a very low priority in the South African housing market. Few homes, at all income levels, incorporate insulation or passive solar measures. And, for parts of the country which experience extended cold winters, it is rare to find central heating. Because of the large number of homes that must be built in the low-cost housing sector, and the fact that these families are poor and spend up to of 28% of their income on energy (Eberhard & van Horen, 1995), the introduction of energy efficiency measures in these homes would produce significant positive benefits to those families and others. Additionally, from a global perspective, increasing the thermal efficiency of the dwellings will decrease the amount of energy consumed for space heating and thus reduce GHG emissions.

While housing delivery got off to a slow start, with only 30,000 houses in the first two years, as of November 1997, 400,000 houses have been built or are under construction (Bower, 1997; The Citizen, 1997). As the 1999 elections approach, the impetus to increase the number of homes being built for South Africa's poor will cause a major increase in the number of subsidies being approved, and homes being built. The opportunity to introduce energy effi-

2. The Kutlwanong Housing Project

"The future is in our hands and we must carry forward the work needed to finally liberate ourselves from the evils of apartheid."

-Closing statement of the Reconstruction and Development Programme (ANC, 1994).

Kutlwanong, a community whose name means "let's understand each other", is united in its efforts to transform a post-apartheid 'township' settlement into a sustainable community, spurred on by grass-roots development. According to Thami Eland, Chairperson of the Kutlwanong Civic Executive Committee, "We are starting the development process with the people, and building them up."

The Kutlwanong Housing Project is the result of the United States - Republic of South Africa Gore-Mbeki Binational Commission (BNC) Energy Conference held in Kimberley in 1995. Several community leaders attended the conference, and this spawned a decision by the Kutlwanong Community to use the environmental engineering firm of PEER Africa to help plan and rebuild the 'township' into a holistic, sustainable, and economically viable community. The intent was to incorporate environmental and energy efficiency awareness, economic upliftment and capacity building into the planning, development, and implementation process.

The project was conceived to provide homes, jobs, an improved quality of life, and other social benefits to a historically disadvantaged community of South Africa. A benefit to the global society of this project, the subject of this case study, is the anticipated reduction in greenhouse gas emissions. This exemplar housing project brings together the goals of the Kutlwanong Community, the priorities of the RDP and an environmental objective of the global community. In addition to building the strength and cohesion of the Community of Kutlwanong and empowerment and development objectives of the national government, the project will also result in the reduction of greenhouse gas emissions, a priority issue for the United Nations.

Picture 1. Thami Eland, Chairperson of Kutlwanong Civic Executive Committee.

Picture 2. Kutlwanong Residents at the ECO™ Home Opening, 20 May 1997.

2.1 Description of Kutlwanong

Kutlwanong is located eight kilometres from the city of Kimberley in the Northern Cape Province of South Africa. Kimberley is world-famous for being the site of a major diamond mining operation at the turn of the century which created a large cavity called the "Big Hole". Figure 1-1 (on page 1) shows the location of Kutlwanong with respect to the Northern Cape Province and South Africa as a whole.

Over 8,000 residents constituting approximately 2,300 families reside on an area of roughly 129 hectares. Kutlwanong was founded in 1994 through an effort of a local civic organisation putting pressure on the municipality to establish a recognised community from the growing settlement. People came to settle the land from the backyard dwellings and shacks and from other informal settlements in the Kimberley area. While a demographics survey has not been conducted in Kutlwanong, the neighbouring community of Galeshewe was studied in 1992 and general demographics can be expected to be approximately equivalent to those of Kutlwanong (Golding and Hoets, 1992). This assumption was confirmed by the Kutlwanong Community leaders.

The 1992 survey of Galeshewe found an average of 4.6 people per informal shack. The average income per household was R660 (US \$147) per month. Table 2-1 presents the findings from this survey.

Table 2-1. Galeshewe Demographics Survey, 1992.

Number interviewed (percentage of total)	188 (74%)
Average number in household	4.6
Adults	3.2
Children	1.4
Household Income (R/month)	
Up to R400 (up to US\$ 90)	29%
R401 - R800 (US\$ 90 - 180)	45%
R801 - R1,200 (US\$ 180 - 269)	17%
R1,201 - R1,600 (US\$ 269 - 359)	6%
R1,601 and above (US\$ 359 and above)	4%
Average household income	R660 Rand (US\$ 147)

Note: According to community leaders, data is approximately equal to demographics of Kutlwanong. Source: Golding and Hoets, 1992.

Following national trends with respect to informal settlement planning, Kutlwanong is not conveniently located. Potential places of employment and shopping are far away, and transportation is a luxury. Unemployment is high, ranging from 60% to 75%, and the isolation from mainstream economic activity tends to perpetuate this situation. The community has little opportunity, at present, to reverse its negative economic situation. Further complicating matters, the community is situated adjacent to a large municipal storm-water runoff holding pond. Land plots in the area are frequently water-soaked, and are not suitable for building. Additionally, the holding pond creates problems with mosquitoes, rats, snakes, and other vermin.

Kutlwanong has adequate infrastructure: paved and wide streets, electricity, wired and cellular telephone service, drainage, and individually serviced (water and sewerage) plots. However, there are problems with the existing drainage and sewage systems, which result from the installation of inferior/inadequate design and poor construction techniques.

The provision of formal housing is a priority for the community. At present, the majority of the community live in 20 to 30 square metre shacks constructed of corrugated iron sheeting. These shacks have no ceilings, and curtains are often used as room dividers. The shacks are draughty, and cardboard can be utilised as a wall cover for cracks and to provide a modest insulation benefit. The dwellings have been found to be colder inside than out in the winter, and hotter inside than out in the summer. During the winter months it is common to see people sitting outside on the north side of their shack to get warmth from the sun.

Picture 3. Picture of shacks. Present housing stock in Kutlwanong

Households use fuels such as low-grade coal, wood, and kerosene for cooking and heating the shacks in winter. Use of these fuels inside the home creates considerable indoor air quality problems, as well as contributing to the degradation of local air quality. In the winter, one can see from a distance a cloud of smoke over the community in the morning and evening resulting from the use of these fuels for heating and cooking.

While no energy survey has been completed for Kutlwanong, fuel usage data was obtained during the 1992 Galeshewe demographics survey. The findings from the energy portion of the survey were confirmed as being comparable to those in Kutlwanong by the community leaders. The data from this survey are presented in Table 2-2, along with the annual CO₂ emissions that would result from the consumption of that energy. The introduction of thermally efficient homes would decrease the emission of CO₂ by substantially reducing the need for space heating.

Table 2-2. Fuel consumption of Informal Households in Galeshewe

Fuel type	% of households	Average Used per month	Average Used per year	CO ₂ per year
Kerosene	99%	26 litres	312 litres	825.4 kg
Coal	5%	59 kgs	708 kgs	1940.8 kg
Wood	9%	16 kgs	192 kgs	316.6 kg
Gas	< 5%	n/a	n/a	n/a
Candles	68%	28	336	n/a

Note: According to community leaders, data is approximately equal to fuel consumption in Kutlwanong
Source: *Golding and Hoets, 1992; Energy Research Institute, 1995; OECD, 1991.*

2.2 Political structures

The community is governed by an elected council of eight, called the Kutlwanong Civic Executive Committee. The Executive Committee was elected by the Community in 1994, and consists of the following individuals:

- Mr. Thami Eland, Chairman
- Mr. Zombo Jansen, General Secretary
- Ms. Mittah Kolberg, Representative, Unit 3
- Ms. Maggie Bendow, Representative, Unit 1
- Mr. Vincent Diraditsile, Representative, Unit 1
- Mr. Joe Selai, Representative, Unit 4
- Mr. Patrick Mothelesi, Representative, Unit 2
- Mr. Tebaho Motshabeng, Representative, Unit 4

The Executive Committee of Kutlwanong are visionary in their outlook in the pursuit of improving the quality of life in their community. Through their proactive actions to plan and build their community, they have developed a framework which will facilitate the development of Kutlwanong and has challenged both provincial and municipal officials in its implementation. The decision to select an energy efficient home for the new housing stock, and to become a pioneering community with respect to housing in South Africa demonstrates the exceptional foresight and perseverance of the Kutlwanong leadership.

Picture 4. Joe Selai and his daughter.

"The Executive Committee is committed to building a stable, family-oriented community. We are proud of Kutlwanong and want to make it the best."

The Executive Committee works closely with its community to ensure that they have support in their initiatives. Recently, they were successful in securing a recreational area, a mobile police station, and a post office. A day-care centre is also in the process of being planned. The Committee was also successful in motivating the municipality to provide electric power

to the community. That project started in early 1996, and as of November 1997 nearly 100% of the dwellings have been connected to the grid.

Because housing is a priority, the Executive Committee met with many developers before selecting PEER Africa to assist in organising the community for training and building the new homes. To manage the initiative, the community established a Housing Subcommittee. The members of this Subcommittee include:

Mr. Thami Eland,
Assistant Project Manager

Mr. Zombo Jansen,
Administrative Secretary

Ms. Mittah Kolberg,
Site Management

Ms. Maggie Bendow,
Site Management

Mr. Vincent Diraditsile,
Site Management

Mr. Ivan Babuseng,
Site Management

Picture 5. The Kutlwanong Housing Subcommittee. From left, Ivan Babuseng, Mittah Kolberg, Vincent Diraditsile, Willie Johnson (PEER Africa), Maggie Bendow, Zombo Jansen, and Thami Eland.

The Housing Subcommittee was formed to work directly with PEER Africa to develop a community-oriented, self-build construction strategy. Douglas Guy, Operations Manager, PEER Africa and Willie Johnson, Project Manager for the Kutlwanong Housing Project both worked closely with the community to develop this housing delivery framework. The two main goals of the Subcommittee are to provide homes to the community and to participate directly in the management and development of the project for the community.

2.3 The ECO™ Housing Project

2.3.1 PEER Africa (Pty) Ltd.: The community-based organiser & developer

PEER Africa is a civil and environmental engineering and science consulting firm. Working with the historically disadvantaged communities of South Africa, PEER Africa is concentrating on the creation and development of sustainable, environmentally sound communities. These communities will promote healthier living through the use of energy efficient housing, cleaner fuels, and appropriate and adequate public health and sanitation facilities. PEER Africa worked with the community of Kutlwanong to create an energy efficient / energy cost optimised housing concept called the PEER Africa ECO™ House.

In Kutlwanong, PEER Africa has used community management skills to empower the residents to manage their own housing project. PEER Africa worked closely with the community to design a home that met their needs and lifestyle, was aesthetically appealing, and also incorporated passive solar design and thermal efficiency measures. PEER Africa is dedicated to using the housing delivery process in Kutlwanong as a means of empowering and employing the local people, building economic potential from the ground-up. The Kutlwanong model home and the PEER Africa concept have received wide acceptance

throughout the Northern Cape Province. Indeed, several other communities in South Africa have requested the help and support of PEER Africa.

PEER Africa is promoting this initiative as a "show case" community to demonstrate how housing and energy technology can be a catalyst for the holistic economic upliftment of a community. These two critical components are integrated with small business development to create a more cost effective solution to the basic shelter problems in Southern Africa.

PEER Africa's involvement in Kutlwanong is a direct result of a visit in August 1995 to South Africa by former US Secretary of Energy, the Honourable Hazel O'Leary. This visit was the outcome of a promise made to President Mandela by US President Bill Clinton under the Binational Commission (BNC). The BNC is a co-operative working agreement between the United States Government and the South African Government, and is chaired by US Vice President Albert Gore and South African Deputy President Thabo Mbeki. The Kutlwanong housing project is part of the BNC's Integrated Housing Programme.

Picture 6. Zombo Jansen, Administrative Secretary, Housing Subcommittee

"PEER Africa was the first organisation to present us the concept of energy and housing together."

The US Department of Energy provided a grant to build the demonstration house in Kutlwanong, while PEER Africa provided the resources necessary to organise, familiarise, and train the community to build the house. That was the first of nearly 200 homes that are currently being completed. There are another 2,100 that are planned for construction over the next two years. All 2,300 homes are being built using the RDP subsidy funds of 15,000 Rand per house. Additional support was secured from the US Agency for International Development for capacity building of both the construction teams and the management team, and for the tools necessary for construction.

During the US Secretary of Energy's visit to South Africa, the delegation held workshops in Kimberley with local and national energy officials. The visit to Kimberley was hosted by the Premier, Manne Dipicio, and the Housing Minister, Pakes Dikgetsi. PEER Africa and its local business partners encouraged the leaders of Kutlwanong to attend the workshop and to determine whether they would be interested in participating in potential projects resulting from the meetings. During the workshops it became clear that the community leaders were keen to learn more about this new concept of combining energy efficiency with housing. At the conclusion of those workshops, PEER Africa, the Kutlwanong Community, the Northern Cape Province Housing Department, the US Department of Energy, and the South African Department of Minerals and Energy signed a Memorandum of Understanding (MOU) to develop and implement this innovative housing concept. The Kutlwanong Community would be the site of the first such project in South Africa.

During the nine months following the signing of the MOU, PEER Africa met frequently with the community leaders to explain the benefits of passive solar housing construction, how the self-help programme would operate, and to develop confidence and camaraderie among all parties. Diagrams and flow-charts were presented to help the community better understand the concept. Community general body meetings were held to inform the residents of this concept, and how PEER Africa would assist them in building their community. Meetings were also held with the local municipality and housing ministry. Several follow up meetings were conducted with the Premier of the Province and considerable correspondence was provided to the BNC to keep it abreast of the progress.

Picture 7. Lilia Abron (President of PEER) and Douglas Guy (Operations Manager of PEER Africa) in front of the demonstration ECO™ home in Kutlwanong. (Note plaque recognising signatories to MOU)

The community leaders were also taken several times to meet representatives from the South African Department of Minerals and Energy and the National Department of Housing in Pretoria. Meetings were also organised with over 20 other formerly marginalised communities to view the type and quality of housing being built elsewhere with subsidy funds. Numerous strategy, planning, and negotiating meetings were also held with officials from the Development Bank of Southern Africa (DBSA), the Mayor of Kimberley, the local housing department, the local municipality, and political organisations responsible for advancing the housing initiatives. During visits to the DBSA, documents relating to financing community based housing and infrastructure were acquired and used as reference material for developing the community vision and project plan.

2.3.2 The Housing Subcommittee: The project implementers

The primary objective of the Subcommittee is to provide shelter and employment for as many residents as possible. It was also agreed that the homes should be energy efficient and that all aspects of project management would be done with Housing Subcommittee participation. Project management, administration, payroll, quality control, and purchasing were all to be done in a manner that would lead to the community ultimately managing the project on its own. It was also decided that a self-help/non-contractor based project was desired. This would allow for as many community workers to be hired as possible. In order to make this work financially, the community workers were requested to and accepted fixed price compensation to help control costs. While self-help was desired, it was accepted by the Subcommittee that some outside skills would have to be used to keep delivery up and to augment capacity and skills where needed.

The Kutlwanong style house is a product of participative management and design by PEER Africa. The process involved first understanding the resident's acceptable living standards and developing those standards into a basic house plan (Figures 2-1 and 2-2). The residents defined the number of rooms and the total space required to achieve a liveable, comfortable home. PEER Africa incorporated that "wish list" into its pricing model to see what could be built for the funds available. This information

Picture 8. Douglas Guy of PEER Africa conducting a Housing Subcommittee Planning and Informational Meetings.

was then given back to the Subcommittee for their decision on what would be included in the final, basic home design, and what would be ultimately left out. To obtain consensus, PEER Africa conducted workshops in the community and compared field data from visits to other community building projects. Home shelters and layouts were provided initially by ASCH Consulting Engineers and discussed with the community leaders and presented at various community meetings. Residents raised issues concerning their lifestyles which were not initially obvious to the engineers and architects. These modifications were incorporated into the design.

PEER Africa provided the technical input to the design of the house from a thermal efficiency perspective. Several iterations and plans were drawn up and consultation was obtained from the United States Department of Energy Laboratories and the South African Department of Minerals and Energy. PEER Africa also hired several architects to assist in evaluating thermal efficiency options.

Picture 9. ECO™ House awaiting the installation of the ceiling insulation

2.3.3 ECO™ Housing incorporates passive solar housing design

The "Kutlwanong Style" house has its origins based firmly in key no-cost / low-cost measures that achieve energy savings and GHG emission reductions, including:

- Correct (Northward) orientation of the dwelling;
- Placement of windows on the North side of the house to maximise thermal benefit in winter when sun is low on the horizon;
- Extension of roof line to shade windows during summer when sun is high on the horizon and thus minimises unwanted solar gain;
- Installation of an insulated ceiling (see Picture 9) to moderate the thermal comfort zone in the dwelling;

- Installation of wall cavity insulation to further prevent heat loss in the winter and heat gain in the summer;

The house is based on an insulated cavity wall system using a steel frame as the basic structure and polystyrene as the primary insulating material. The homes are face north and window systems are designed to maximise solar gain during the cold months. Roof overhangs are used to shade window systems during summer. The outer skin of the home is a single layer of brick, while the inner walls are made of gypsum board. The inner walls are finished and painted by the community teams before the dwelling is turned over to the home owners. All of the homes have insulated ceilings and are made from products that are easily obtainable in South Africa.

Picture 10. Community Team assembling the steel frame of an ECO™ House

Figure 2-1. Sketch of the Kutlwanong Model ECO™ home with veranda option

Source: PEER Africa, 1997.

Figure 2-2. Interior Floorplan for the Kutlwanong Model ECO™ home

Source: PEER Africa, 1997.

2.3.4 Barriers to project implementation

The barriers to project implementation may be divided into three categories:

- Barriers faced by the developer, PEER Africa;
- Barriers faced by the Community; and
- Barriers faced by the Housing Delivery Process.

Barriers faced by the developer, PEER Africa, included the lack of bridge financing and the lack of available expertise concerning energy efficiency and passive solar design in housing.

The Housing Implementation Manual requires the developer to build homes at risk and recover funds after the structures are approved by the home-owner. This dictates the use of established developers and contractors with banking and financing facilities in place. PEER Africa is a new business in South Africa, and therefore it is difficult to obtain credit to finance its operation. The same holds true for most emerging developers and community-based contractors. The Department of Housing has recognised this problem and is working with financing institutions to develop innovative lending solutions for the low-income sector.

The South African banking community has not yet embraced the idea of funding development in historically disadvantaged communities. As a result, most emerging developers and community contractors can not get loans or financial support to assist in the construction of homes, or the rebuilding of previously marginalised communities.

The Kutlwanong community, under the advice of PEER Africa, chose to operate their housing initiative as a project-linked subsidy scheme, allowing the contractor (the Community) to be paid in increments as construction progressed. Support was also provided in order to negotiate lower prices of building materials through bulk procurement.

This decision facilitated PEER Africa's participation. Bridge financing is still being sought, but this method allowed the company to build a track record in South Africa which will demonstrate its creditworthiness.

The apparent lack of available expertise in energy efficiency and passive solar design in housing in South Africa makes a project of this type difficult and expensive to implement. There are South African architects who understand the principles of good thermal design, but time and again buildings and houses are built with no attention paid to passive solar or energy efficient measures. The housing project in Kutlwanong is a shift from text book to practice - a transition which would be desirable on a national level in South Africa, particularly in areas with cold climates like Kutlwanong. The housing project in Kutlwanong is the first large scale delivery of thermally efficient homes.

Picture 11. Dr. Lilia Abron of PEER Africa hands over the keys for the first ECO™ House to Provincial Minister of Housing and new owners Mr. and Mrs. Diruditsele while the Mayor of Kimberley (far right) looks on.

The Kutlwanong housing project is also unique because a historically disadvantaged community would normally be one of the last to be provided with innovative technology to overcome problems like high energy use, pollution and discomfort. PEER Africa conducted numerous workshops with the community leaders and residents to define the science, technology, and concepts behind energy efficient housing. Local television and radio programs were contacted to solicit support in disseminating the information to other communities and builders outside the Kutlwanong area. Finally, PEER Africa obtained the services of research architects and scientists to improve the level of information available to the community and assist with project implementation.

The major barriers faced by the community were the initial amount of the subsidy the municipality wanted to claim for the capital costs of services, and the lack of affordable housing design alternatives in South Africa.

An analysis of the subsidy implementation manual and the flow of the capital subsidy funds disclosed an opportunity for the community to request a better approach to paying for the land and infrastructure. The normal implementation policy provides an option for the local municipality to deduct their costs for developing the infrastructure of a given low-income community from the RDP subsidy. The municipality rarely justifies the amount taken, which can be as high as R11,250 (US\$2500) per site. The Kimberley municipality initially planned to take R7,500 (US\$1667) from the subsidy allocation, however negotiations with the municipality succeeded in reducing that sum to R2,500 (US\$555).

PEER Africa and the Subcommittee then presented a motion to the city council requesting that the community be given the full subsidy for the top structure, and that the municipality find another source of funds to pay for the capital costs of the services. In return, Kutlwanong would keep its rate payments current, and the rates should pay for the system over time, as is the practice in other parts of Kimberley. The City Council agreed with the community, approved the full subsidy amount for the top structure, and paid the R2,500 (US\$555) for the capital costs of services out of their own funds.

Throughout the country, builders are not being creative in their approach to building homes in the formerly marginalised communities. They tend to build the cheapest structures that offer them high profits. Many of the developers also have a vertical monopoly on the structures they build, either manufacturing all the necessary materials themselves or purchasing from partner companies. Developers also do not enter into consultation with the communities to develop specific housing guidelines and criteria that contain the community vision. In contrast to the typical developer, PEER Africa provided several housing concepts to local engineering firms for development. These designs were then presented to the community and modified by them. The Kutlwanong home was then registered with the municipality and approved by the community. It is now called the Kutlwanong model and is one of the home designs that has already been accepted and requested by two other historically disadvantaged communities in the Western and the Eastern Cape.

Picture 12. The Kutlwanong Model.

The barriers faced by the housing delivery process include the high costs of building materials, country-wide delays in delivery of materials, lack of equipment and machinery, lack of sufficient capacity to deliver in a timely fashion, and the high cost of transport of materials and supplies.

Building materials can consume as much as 85% to 90% of the top structure costs in the low-cost housing market. This problem sparked the Housing Subcommittee to work with PEER Africa in developing a plan that focused on reducing the costs of building materials. The plan developed into a set of proposals that provide for bulk purchase of building materials and supplies at significantly reduced rates. The savings on materials allow for the construction of a home with greater floor space, built with good quality building material, including insulation. The key to success in this approach was the co-operative agreement developed between private industry and the housing programme. The bulk purchase programme was recognised by the South African Department of Trade & Industry and is now a key component in a national initiative of the Department.

Once the project was approved and bulk purchase agreements were put into place the residents and community leaders were anxious to start building the homes. In order to move ahead the community is currently working to overcome the following obstacles which are common throughout South Africa:

- Lack of appropriate and sufficient equipment and insufficient time and money to train community members as builders.
- High cost of transport. The favourable pricing arrangements are offset somewhat by the costs of transport for the goods. The issue is so significant that it has been turned over to the national Housing Ministry for resolution.

2.4 Stakeholders in housing delivery in Kutlwanong

There have been many companies, organisations and individuals involved in the Kutlwanong Housing Project. The following list identifies some of the key role players who have been involved with the Kutlwanong Community and PEER Africa:

Manufacturing and Materials Suppliers

- Manayam SA (Pty.) Ltd., Praveen Manayam
- Sagex, James Cronin
- Mitek, Earl Damons
- Gypsum Industries, Randall Everson
- Cumulus Insulation, Sean Curran
- Cadars Brick and Transport, Sakie Cader
- Brick n' Tile (Pty.) Ltd. / Corral Brick, Mike Ingam, Rod Taylor, V. Zuma
- Alpha Cement, Jackie Pheeha
- Coverland, Johan van Jaarsveld
- Rollco Roofing Systems, Amien Jardine
- Bluechip Paints, Joe Somawonga
- Visual Energy (Stoves and Low Smoke Fuels), Hennie Beukes

Research and Development / Consulting Engineering

- Stanley Manong Engineering / ASCH Consulting Engineers, Stanley Manong, Gavin Cooper
- Sustainable Design Group, John Spears
- Bechtel, Dr. Larry Papay
- Matingi & Associates, James Ngobeni
- PWP Architects & Associates
- Department of Minerals and Energy

Marketing and Business Development

- Foster and Associates, Charlene Foster
- International Institute for Energy Conservation, Lloyd Wright

Logistics / Financial

- Quanta Ntsebeza Attorneys & Conveyancers, Christine Qunta
- KMMT Brey - Chartered Accountants, Abdurrahiman Motlekar

3. What are the Results of the Kutlwanong Project?

In South Africa, energy efficiency and low-cost housing are generally considered to be mutually exclusive. The Kutlwanong housing project counters this belief, and demonstrates that through a process of balancing social, economic and energy objectives, a superior housing product can be achieved which is both energy efficient and affordable.

The benefits to households of energy efficient housing include a reduction in heating fuel costs, an increase in comfort and quality of life, and henceforth an improvement in the family's health. On national and global levels, the benefits include reduced expenditure treating respiratory illness and burns, a reduction in regional air pollution and a reduction in greenhouse gas emissions. The PEER Africa ECO™ housing project in Kutlwanong provides all these benefits, through a holistic approach to the developmental and environmental needs of the community. The housing delivery process employed in Kutlwanong has produced benefits not only to the household, the community and the environment, but also to the suppliers and contractors.

3.1 GHG mitigation

A household energy survey of Galeshewe provides a profile of energy use which has been determined to be representative of Kutlwanong (Hoets and Golding, 1992; Abron 1997). The survey found that 95% of households in this area used only kerosene, 4% used both kerosene and coal and 1% used just coal to meet their household energy needs. Research into the energy usage patterns in low-income households in South Africa indicates that those households using both kerosene and coal are likely to use coal for space-heating purposes (Simmonds and Mammon, 1996). Therefore, it can be assumed that 95% of the households in this area use kerosene to meet their space heating requirements and 5% use coal.

Picture 13. Kerosene and coal cook stoves are used in Kutlwanong for cooking and heating.

An informal energy survey conducted in Kutlwanong (1997) revealed that households use an average of 35 litres of kerosene per month to meet their winter space-heating requirements. National energy surveys of the cold interior region of South Africa show that households using coal for space heating normally consume 88.5 kilograms of coal per month to meet their requirements (Simmonds and Mammon, 1996). These two figures are used as energy consumption estimates for space heating in Kutlwanong during the four month winter season.

No formal monitoring text have been conducted on the PEER Africa ECO™ House. However, computer simulated models have predicted a 70% energy saving of the household space-heating bill for thermal efficiency improvements. This figure is used as the central

estimate for CO₂ mitigation calculations, with a 10% deviation from the estimate to either side (see Table 3-1).

Table 3-1. Energy use for Space Heating, and savings for a PEER Africa ECO™ house

	Kerosene	Coal
Fuel used per household for space heating per winter month	35 litres	89 kg
Fuel used per household for space heating during winter (4 months)	140 litres	356 kg
CO ₂ emission factor (OECD 1991)	2.65 kg CO ₂ / litre	2.74 kg CO ₂ / kg
CO ₂ emissions during winter (kg/house/winter)	370	970
CO ₂ savings from the ECO™ home at 60%, 70% and 80% reduction scenarios (kg/house/winter)	222 / 259 / 296	582 / 679 / 776

To calculate the annual energy savings achievable with the ECO™ house, the estimates in Table 3-1 have been summed over Kutlwanong's four month winter period (May to August). The anticipated energy savings for a household using kerosene is 84 to 112 litres per annum, which translates into a CO₂ savings of 222 to 296 kilograms. For households that heat with coal, a saving of 582 to 776 kilograms of CO₂ is expected. In the community of Kutlwanong, 2,300 ECO™ homes planned to be built over the next several years. The carbon dioxide emissions reduction achievable with these thermally efficient houses is between 583,000 and 777,000 kilograms per annum (see Table 3-2).

Table 3-2. Carbon dioxide reductions for housing project

	Kerosene	Coal
CO ₂ savings from the ECO™ home at 60%, 70% and 80% reduction scenario (kg/house/winter)	222 / 259 / 296	582 / 679 / 776
Number of households using each fuel for space heating	2,100	200
Total housing project CO ₂ savings (kg/annum)	466,200 - 621,600	116,400 - 155,200
Net savings (Kerosene & Coal) for 2,300 homes	582,600 - 776,800 kg/annum	

Note: these data are preliminary estimates.

3.2 Income-related benefits

Hoets and Golding (1992) found that 74% of households sampled in Galeshewe earned less than R800 per month (US\$178) and that the average income per household was R660 (US\$147), well below what is considered the minimum standard of living in South Africa. Information obtained from the subsidy application process for this housing project suggests that the Kutlwanong community is experiencing a similar, if not worse, level of poverty. Most of the families in Kutlwanong earn less than R800 per month, a situation exacerbated by unemployment levels between 60 and 75%. For these households living below the poverty line, fuel requirements are a large component of monthly expenditure. The poor thermal performance of low-cost housing places a considerable financial burden on the poor, par-

ticularly in cold climate areas like Kutlwanong, where approximately 50% of energy consumption in the winter months is for space-heating.

During winter, households in Kutlwanong use approximately 35 litres of kerosene per month for space-heating. With kerosene costing R1.75 (US\$0.39) per litre, this amounts to a monthly cost of R61.25 (US\$13.61) for space-heating alone. If the ECO™ house is estimated to reduce space-heating requirements by 70%, households will save approximately R43.00 (US\$9.56) per winter month or R172.00 (US\$38.22) per year. This represents a substantial saving for households facing limited financial resources. Reducing the energy operating costs of the house is significant in that it releases scarce financial resources for other household needs. Speaking about the benefits of the ECO™ Home, Zombo Jansen, the General Secretary of the Kutlwanong Civic Executive Committee, stated:

"It means that our people are not going to use a lot of money to heat their homes. They can use the saved money to feed their families, send their kids to school and provide for other needs."

3.3 Health and safety benefits

There are many public and environmental health issues associated with the use of energy in the low-income sector. Many of these negative health and safety problems are magnified during the winter months, when household fuel use increases to meet the need for space heating. The PEER Africa ECO™ House will positively impact the frequency of these health effects by reducing the need for space heating. More specifically, these health and safety benefits associated with an energy efficient house include:

- A reduction in respiratory disease and other illnesses, particularly among women and children. At present, black South African children under 5 years old are 270 times as likely to die from a respiratory infection as children in Western Europe (von Schrinding, 1991);
- A reduction in energy related accidents (e.g. burns, fires and poisonings). In South Africa, over 15,000 children are hospitalised annually from kerosene poisonings and burns are one of the top four killers of children under 14 (Eberhard and van Horen, 1995);
- Savings on household / government expenditure on healthcare - direct and indirect health savings will amount to R500 million (US\$111.1 million) per annum (Basson, 1996).

Exposure to indoor smoke degrades the body's defence mechanisms and makes people more susceptible to respiratory infections such as pneumonia and tuberculosis. After diarrhoea diseases, respiratory infections are the second largest killer of children under five in South Africa. This can, in part, be attributed to exposure to indoor smoke. Nationally, treating the victims of respiratory disease (those who are able to access a hospital) costs the country R307 million (US\$68.2 million) per annum (van Horen, 1996); an amount that could be well spent on meeting other needs. There is also substantial risk associated with the use of these fuels in the home. Gaseous emissions, principally carbon monoxide, produced during the burning of these fuels can cause death in the home. A recent survey conducted in the Kutlwanong informal settlement found that in 50% of the sample households using kerosene for cooking and heating and 50% of the sample households using informal coal heaters, there were dangerously high levels of carbon monoxide indoors (Freeman *et al.*, 1997).

Particulates are released during the burning of coal and wood, and through the inefficient combustion of kerosene. High levels of exposure to particulates have been linked to respiratory diseases (such as pneumonia), cardiac arrest and lung cancer. Studies of indoor air pollution in urban coal-using households in South Africa found that people's exposures to hazardous air pollutants, especially particulate matter, exceeded WHO health guidelines by

a factor of two to three in summer and six to seven in winter, when households increased their use of coal to meet their space-heating requirements (van Horen, 1996).

Kerosene use also creates extremely hazardous conditions in the home. Cases of poisonings from kerosene ingestion exceed 15,000 per annum, and accidental fires that consume several shacks can spread rapidly, injuring or killing residents and destroying property. Kerosene poisoning is most common among children in low-income areas between the ages of one and three. In these areas, kerosene is dispensed by informal traders in a variety of containers, including reused cold drink bottles. These containers are often mistaken by children and adults for a soft drink, and are (partially) consumed. Household surveys in various parts of South Africa suggest that between 1% and 6% of poor urban households have experienced incidents of poisoning in the recent past (van Horen, 1996).

There are less data available on the incidence of fires and burns, but newspaper articles on fires resulting from accidents with kerosene and candles suggest they are a frequent hazard. Fires not only result in injuries and fatalities, but also place a considerable financial strain on low-income households when they need to rebuild their houses and replace household contents after losses in these fires.

South Africa has a number of initiatives that are trying to address these health and safety concerns. These include a national electrification campaign, a programme to develop and promote low-smoke fuels and a national kerosene safety programme. As a compliment to these initiatives, energy efficient housing provides a direct means of reducing the negative health impacts and safety hazards. The ECO™ house is designed not only to improve thermal performance and reduce energy consumption for space-heating (thus reducing levels of indoor air pollution), but also to provide outlets/exhaust vents for noxious fumes from coal and wood stoves. Further, the ECO™ House is constructed from materials that do not readily burn (i.e. brick, steel and treated insulation) thereby further reducing the risk of house fires. Energy efficient housing will not only reduce the aforementioned problems experienced during the winter, but it will also improve indoor environmental conditions throughout the year, thus enhancing the general well-being and productivity of the occupants.

3.4 Benefits to the community

With the national government objective to provide 1,000,000 homes in five years, the housing delivery process has been concentrated down to focus on and meet three basic needs: secure tenure, services and shelter. Housing delivery is however only the first step down a path addressing many critical needs in the most impoverished communities in South Africa. The Kutlwanong Project differs from the status quo of housing projects because it starts from the point of developing a Community Development Framework (PEER Africa, 1997). This Framework works at the grassroots level to identify the needs and objectives of the community. It then develops a process by which the housing delivery process, a substantial investment in the Community, can work to best achieve these goals.

3.4.1 Community empowerment

The Kutlwanong housing project is a self-help, community development programme. The people of Kutlwanong decided to manage the housing project and build without the direct involvement of a building contractor. The project was initiated by the community, which through its leaders has been involved in the project management, decision making and negotiations. At the start of this process, a decision was taken by the community to solicit input from PEER Africa, who pledged to facilitate and assist the community in realising its goals of self empowerment.

The community has strong leaders who have further developed their leadership and negotiation skills through interactions with a wide range of stakeholders in the implementation of this housing project. PEER Africa provides direct management, hands on training and development guidance to the leaders. The PEER Africa Community Development Framework, which was developed in close discussion with Kutlwanong, was used as a basis for providing the community leaders with access to various management skills as well as the technical and financial aspects of the project.

Picture 14. Work crew and managers who built the show house.

PEER worked closely with the community to develop a set of standards, goals and objectives which were used as a basis for discussion with the municipality and other groups. Having taken part in these negotiations, the community leaders have acquired the diplomatic skill of using the new democratic process in South Africa to forge agreements with the city council regarding future community needs.

The community leaders are beginning to market their newly acquired negotiating skills and knowledge with other communities. Already, they have been approached by the neighbouring Galeshewe Civic for assistance and have addressed the Guguletu community near Cape Town from their experiences setting up and managing the Kutlwanong housing development project. Job creation, local business opportunities, local industrial park

The housing project in Kutlwanong has translated into paid employment for residents of the community. Over 120 community members are presently employed as builders on the project. While most of these community builders are not presently artisans, they are receiving on-the-job skills training required for the completion of the house, and they are expected to be artisans by the time this project is finished. In addition to the construction workers, seven community leaders are partaking in and learning from on-going project management and technical issues relating to the project. PEER Africa is working to make the community self-sufficient in delivering the next 2,100 homes it has planned.

Picture 15. Community work crew mixing concrete for a foundation.

The Kutlwanong leadership and PEER Africa are committed to the empowerment of women through this project. This has resulted in conflicts at the community level for several reasons. There is a high unemployment rate among the men, and some men feel it is their responsibility to generate income for their families before women are trained. In other instances, the women see construction as "men's work" and either drop out or don't get

involved in the project. At present, approximately 10% of the community work-force is composed of women, with two in each of the building crews. Several of these women have demonstrated leadership and artisan skills sufficient to head new construction crews that will be formed during the next phase of the housing project.

While building the houses generates only short term employment, individual community members are looking forward to using the skills that they have learned from the housing project for life-long employment. Indeed, according to Josiah Pienaar, a steel frame erector from the community, "I am very pleased to have this job. I went to school to learn metal work. I am learning how to build a steel frame house. I can now support my family, and hope to start a business building steel frame structures when this project is finished."

A range of different skills have been identified by the Kutlwanong community leaders for future development, including photography, burglar bar manufacturing, carpentry, and cabinet-making. Working with PEER Africa, the community leaders also seek to develop local business opportunities which emerge out of the housing process. For example, there exists potential to set up local steel frame manufacturing or insulation cutting companies.

Picture 16. Josiah Pienaar, steel framing erector and resident of Kutlwanong.

3.4.2 Local Industrial Park Programme

Recognising the need to increase employment levels in low-income communities, the Deputy Minister of the South African Department of Trade and Industry (DTI), Phumzile Mlambo-Ncguka, initiated a plan to develop business zones in parallel with housing projects (see Figur). The conceptual plan aims to encourage private sector involvement in the RDP and to stimulate business growth and employment opportunities near communities gaining access to new housing. The Community Development Framework developed by PEER Africa and the Kutlwanong community has become a part of this national programme. PEER Africa is working closely with the DTI to incorporate both ECO™ building technology and emerging business development into target communities. Two members of the Kutlwanong management team travelled to Cape Town to meet the Deputy Minister and to participate in the opening of the first Local Industrial Park (LIP) in the country. This visit was quite an honour for the two members of the management team, because Kutlwanong Model is the first show house to be built on an LIP site. Kutlwanong leaders and the Kimberley City Council are presently working together to plan the future development of a LIP near Kutlwanong.

3.5 Electrical peak reduction—Benefit to Eskom

Eskom is particularly concerned about creating new residential demand for space heating. Already, South Africa experiences its peak electricity demands on the coldest nights of the year (Surtees, 1993). Figure provides an indication of the magnitude of this demand side problem. In this diagram of electricity use in Soweto, a cold front had moved through during the monitoring programme. For each day, the morning and evening peaks are clearly evident, and the size of the peaks on the two cold days (8.1 and 9.8°C) highlights the magnitude of the problem Eskom must address.

Figure 3-2. Electricity Demand in Soweto, Correlated with Temperature

In the electricity sector, each successive kilowatt-hour generated and sold does not cost the same as each previous one. This is particularly true in South Africa where the

tions are mainly large base-load plants and do not have much capacity to follow power peaks as they appear on the grid. The bottom line is that peaky demand profiles are expensive to generate and with careful demand-side management can be avoided (Thorne, 1995). A thermally efficient home offers great potential to reduce these peaking loads, through reducing or even eliminating the need for space heating.

3.6 Benefits to suppliers

As mentioned previously, one of the major constraints to building quality affordable housing in South Africa is the high cost of building materials. Among other constraints, the quality and size of typical affordable housing in South Africa is compromised by the fact that large, well-established suppliers continue to enjoy retail profits from most of the housing projects under the government's housing subsidy scheme. Recognising this as a major constraint to the development objectives of the Kutlwanong community, PEER Africa, together with the community leaders, sought innovative contractual arrangements with large and small building suppliers who would benefit from bulk purchasing orders.

Bulk procurement has a clear benefit for the community, who are able to purchase building materials relatively cheaply and rent equipment at low cost. However, it also benefits the suppliers, who through economies of scale are able to obtain their supplies at a lower price, and then recover their perceived profit losses on the Kutlwanong project by achieving wider profit margins on other projects. Other suppliers regard this project as their contribution to the RDP, and as such are willing to sell materials at very near their cost of production.

4. Scaling-up the Initiative: The Replication of Kutlwanong

The ECO™ project has demonstrated the need for replication of energy efficient, passive solar homes throughout South Africa, the SADC region, and the continent of Africa. There exists a need to increase the number of climate responsive homes built throughout the southern African region due to the severe diurnal temperature fluctuations and winter climatic conditions. Additionally, the low-income communities of this region struggle to afford the necessary subsistence energy for cooking and space heating. It is a recognised fact all over the world that energy efficient homes are cheaper to operate, and are more comfortable and desirable. It has been shown by PEER Africa, Holm-Jordaan-Holm and other groups in South Africa that the additional costs of energy efficiency features are quickly offset by the resultant energy savings and quality of life improvements.

PEER Africa is currently assisting with the building or development of housing and other structures in five of the nine provinces of South Africa. The ECO™ technology produces homes that maintain an acceptable "comfort level" in the summer. This feature has attracted the attention of African countries close to the equator, because they are concerned with providing homes and other buildings that remain comfortable without the use of air conditioning. The design PEER uses for their homes are well-known passive solar design principles that insure liveable, affordable, healthy indoor-air environments.

As highlighted in the previous chapter, the ECO™ housing implementation process represents a fundamental paradigm shift in community planning and development. While the local community works to deliver environmentally sound, energy-efficient homes, they also benefit from capacity and skills building, empowerment of the local people, jobs and businesses creation, and economic development. At the community level, acceptability and interest in the ECO™ housing implementation process and structure is strong, and considerable demand for replication has developed. The focus then is to determine what are the necessary steps to replicate this process where requested. This chapter focuses on replication in South Africa. Lessons learned here could form a framework for application throughout Africa.

Picture 17. ECO™ showhouse in Guguletu, Western Cape Province. Note roof overhang for summer shading.

4.1 Replication of the ECO™ house

Replication in the subsidy-based new housing market of South Africa can be accomplished through the community-based self help model or through the use of local small, medium and micro sized enterprises (SMMEs). In Kutlwanong, the local self help model was to construct the demonstration ECO™ house and the first 50 homes. The remaining 150 homes completed to date were done using a combination of the self help model and local SMMEs.

The local self help model focuses on using the labour and managerial skills of community builders and/or the homeowner to build the houses. This method has the advantage of employing many people in the community and retains a greater portion of the subsidy funds in the community. However, it is a relatively slow delivery mechanism, and involves trial and error to get the job done correctly. If proper management and organisation are not instituted and maintained, the project could rapidly deteriorate, and the resulting houses may not meet

building code or community expectations. Additionally, while savings can be made on the labour building the homes, they can easily be lost to building material suppliers due to a lack of grassroots experience in negotiating the cost of the construction materials. Until this skill is developed and refined at the community level, it will be important for groups like PEER to play a supporting role in the management of these projects.

In order to overcome the deficiencies of the self-help model, PEER Africa decided to employ local SMMEs to handle many of the skills not resident in the community. These enterprises were hired to lay brick and erect steel frames. The community crews built the foundations, roofs, and all the interior work (e.g. insulating and installing dividing walls and gypsum board). This approach resulted in the construction of the remaining 150 homes in the same time that it took to build the first 50. Additionally, the quality of the work improved and material wastage decreased. For the construction of the next 500 homes, PEER Africa intends to extend the use of SMMEs. With the agreement of the community, PEER Africa will tender the shell of the house to a local SMME, while the community crews will handle the interior and finishing work. Using this method, it is anticipated that 500 homes will be built in less than three months.

4.1.1 Establishing franchises to expedite national delivery

The use of the community self help method and local SMMEs still require that PEER Africa handle the functions associated with community planning and development, community organisation, management, and overall guidance. In order for mass replication to occur throughout South Africa, organisations with direct linkages to the communities need to be identified and developed to promote this approach to housing delivery.

Through the establishment of franchises, PEER Africa is augmenting their resources and ability to impact housing delivery in South Africa. The franchisee is a businessperson from a particular community or region, who has capacity or skills running a business and managing people. The franchisee will purchase a franchise licence from PEER to handle all aspects associated with the development of sustainable communities in their operating sphere. The franchisee will manage the construction of ECOTM homes and related structures, including crèches, spaza shops, and schools. The franchisee can build the homes themselves, hire local SMMEs, use the community self-help concept, or any combination of these. This delivery concept provides a mechanism to enhance and expedite local delivery, while creating local jobs, businesses and entrepreneurial spirit. This delivery approach will also retain a greater portion of the housing subsidy with the community, and thus contribute to local economic development while enhancing family and community stability. The franchisee would have access to the support network of PEER Africa's centralised technical expertise, experience with the building materials supply industry, and other resources necessary to implement the project. It will be the responsibility of the franchisee to tailor the house design and delivery mechanism to the unique needs of the recipient community.

PEER Africa will not select the franchisee; it will define the boundary of operation. The person or group interested in this arrangement must approach PEER Africa to purchase the franchise. The potential franchisee must develop and submit a business plan and the first project proposal. These documents should demonstrate the delivery approach and housing concept are acceptable to the community, that the individual/group has the support of the community, and that they have the necessary skills to manage and implement the project. If the proposal of an individual or group is accepted by PEER Africa, the franchisee will enter into a thorough training course on delivering a successful project. PEER Africa will then assist with the building of the first demonstration home, and maintain close supervision while the first project is being worked on. Following the successful completion of that project, the franchisee will be encouraged to become independent, and seek more projects. The training of the franchisee will include the necessary planning and community organising, as well as the technical aspects and construction of the home. PEER Africa will assist with all de-

sign modifications of the buildings, while assisting the franchisee in securing project finance and access to negotiated building material supplier agreements.

4.1.2 Replication in middle income market

The middle to higher income subsidy market is characterised by homeowners who are working, have a credit history and can obtain a mortgage for their home. These prospective homeowners can and will purchase larger homes with more up-grade options and amenities. In this market segment, developers are not as constrained by budget and can make a reasonable profit, while providing a home that meets more energy efficient and environmentally sound objectives than the affordable housing segment. For example, technologies such as energy efficient appliances (e.g. geysers, refrigerators, stoves), water-saving technologies (e.g. low-flow shower-heads, dual-flush toilets), and built-in solar ovens.

These housing projects are most often 'greenfield' in nature, meaning the construction takes place in a previously undeveloped area. Therefore, new infrastructure such as water re-circulation, water-borne wastewater treatment systems, and other municipal services will be required. Public facilities such as schools, crèches, hospitals, clinics, and shops can also be provided. For these projects, PEER Africa will serve as the developer, utilising local franchises or SMMEs to build the infrastructure, both above and below the ground. This approach will allow major projects (i.e. 5 000 to 10 000 units and commercial buildings) to be constructed in a timeframe consistent with accepted industry standards.

Thus, replication of the ECOTM house concept is strongly tied to increasing the speed of delivery. In order to be viable in the long-term, the concept also depends on operating in an environment where there is the potential to earn a reasonable profit, while delivering a quality product. The approaches described above will afford replication of the ECOTM process in any situation where it is requested.

4.2 Implementing scale-up and mass replication

4.2.1 PEER Africa

The ECOTM process can be replicated in the subsidy markets, as well as the housing markets in the range of R45 000 to R100 000 middle income markets. Scaling-up to implement replication is the more arduous task. PEER Africa is itself a small business. In order to implement this multi-faceted process, PEER Africa must first increase its resources and financial base to embrace replication. Identifying, securing, and managing the necessary resources are well within the skills of the owners of the business. For the past two years the company has been receiving more than 20 calls a week from communities and developers wanting PEER Africa's assistance, and the ECOTM house or wanting the rights to build the houses. The company cannot possibly keep-up with all of the requests because of its present size.

PEER Africa's major obstacle to scaling-up is an inability to obtain necessary financing to hire staff who could respond to the business demand. This inability is due primarily to the banking system's reticence to lend to a relatively new, small business. PEER recognises that the traditional method of hiring is an impediment to its ability to deliver. Business plans have been developed and submitted to major funding/lending organisations for company growth and development. PEER Africa has been able to secure some bridge financing loans and community facilitation grants from a South African NGO that is backed by an international financier. This, however, took over three years, despite the fact that the company has substantial housing funds and other contractual funds on account in several South African banks. As in many small businesses capitalisation continues to be problematic, even when the business is proven.

4.2.2 Issues for the community, private sector and government

Scaling-up also embraces a new set of issues that require resolution. These issues are perhaps unique to South Africa, as the mass housing delivery programme is unique in the world, and compared to the need, relatively few people in the country are equipped to plan, implement, and manage a project such as this one. Finally, there are issues and attitudes arising from the legacy of apartheid which can severely hamper delivery.

4.2.2.1 Community issues

When a housing delivery process is a self-help project, a myriad of problems will occur when one scales up from one demonstration house to a full community of houses. In-depth knowledge of the political and bureaucratic processes and proven leadership skills are community barriers to scale-up. The community must be trained to do the work, and to assume the necessary managerial and leadership skills to implement such a project. They must quickly learn how to plan where the houses will be built, and in what order people will receive their homes. They must learn how to order and monitor the use of construction materials, how to be vigilant of the prices charged, and how to track supplies delivered on site. They will need to cope with personnel issues such as managing work in the field, and keeping track of all workers (i.e. time schedules, work performed, payroll). The leaders of the project will have to be 'honest brokers', and discipline each other, take and give orders, and avoid nepotism. They will also have to attend to adversaries such as the municipality and other communities jealous of their progress. Finally, the leadership should try and be available to assist other communities who want their help or advice on how to manage a similar housing project incorporating the same principles of integrated housing and social development with environmental sustainability.

All these compounding responsibilities and stresses, in addition to their existing domestic responsibilities can place a major toll on the community leaders and workers involved with the self-help project. The impact on the community will be both positive and negative, and must be managed carefully to ensure delivery of a successful housing project.

4.2.2.2 Governmental issues

While the community attempts to adjust and meet its new responsibilities, the Governmental delivery system presents a considerable barrier to scale-up. The government departments have never been exposed to planning and implementation of housing delivery of this magnitude. The first obstacle is that of a clear policy and guidelines for programme definition, implementation, oversight, and control. The concept is clear, but the strategy for implementation is not. Housing delivery is a national programme, with management responsibilities delegated to the provincial housing departments. From that tier, the local and municipal governments are charged with the actual delivery of housing. This can create some problems, particularly where the municipal government disagrees with policies of the Provincial and National governments. Clarity is also required on the responsibilities of the tiers of government in the decision-making system of checks and balances. Often these responsibilities are left to a person or group that is strong enough to take charge, and they may serve as a deterrent to progress. Another barrier is the discord between the expectations of the people and the ability of the system to respond. There exists a lack of creativity in dealing with the national housing program. This initiative is a major undertaking of the South African government, which has allocated 3% of the national budget to this purpose. The national government deserves credit for such a strong budgetary commitment toward housing the poor, and stakeholders and delivery organisations need to approach the problem with the same magnitude of creativity in addressing barriers.

One of the most significant barriers to scale-up is the reduction of the portion of subsidy available for top-structure by the municipalities and local authorities. The national policy affords local government structures the ability to extract a portion of the subsidy funds to cover

the costs of providing infrastructure to each of the plots on a new site. Sadly, many municipalities perceive the housing subsidy as a revenue generator, enabling them first right to extract what they want of the funds, often without any explanation to how the amount was arrived at. Municipalities often take 50% to 75% of the subsidy allocation (7,500 - 11,250 Rand) leaving little for the top structure. And, as few of the potential beneficiaries qualifying for the subsidy are employed, they are not able to secure a mortgage to pay for a more acceptable top structure. Indeed, in some areas, municipalities have been known to charge the entire subsidy (15,000 Rand) to cover the costs of site and servicing - leaving nothing to build a house with. The Minister of Housing has been alerted to this problem, and she is currently developing legislation to curb this practice.

The practice of paying for site and servicing up front defeats the entire intent of the program and is a major barrier to scaling-up and building throughout the country. Interestingly, no other segment of a municipality's constituency is required to pay the capital costs of services on an up-front, lump sum basis. All other residents pay for services over time through rates and taxes. The municipality however presents an argument that 'these people have a history of non-payment of their services' and thus, they do not wish to incur risks through the housing delivery program. In this way, municipalities are lacking creativity, and are following the old methods of action. Rather, these institutions should perceive the housing subsidy program as a jump-start in the process of taking the historically marginalised and disadvantaged communities and transforming them into productive citizens, contributing to the national economy.

4.2.2.3 Private sector issues

Scaling-up of ECOTM housing delivery very much depends upon the co-operation of the private sector for goods, services, and financing. This program cannot succeed without the participation and support from these groups. The tendency among these organisations has been to follow 'business as usual', with high mark-ups on building material supplies. Due to a lack of competition in the market-place, the consumer ends up on the losing end - with their fixed subsidy buying less material with which to build their house. Building material suppliers, craftspersons, labourers, and building professionals must get involved in the housing delivery program in a manner that ensures success for all.

With experience from the Kutlwanong project, PEER Africa has been assisting the South African Government in developing solutions to the problem of building material cost. In Kutlwanong, for example, a major barrier to scale-up was removed when negotiated bulk purchasing agreements were drafted with building material suppliers. These agreements allow PEER Africa to purchase materials in bulk and thus dramatically reduce building costs. Building materials represent 75% to 80% of the cost of the top structure in the subsidy housing market. Thus, it was imperative to get favourable pricing arrangements with them. These agreements were a major victory in producing a 45 to 50 square metre home within the subsidy. The suppliers were motivated from the perspective of being a part of the development of their country. The suppliers found they met their profit margins on the basis of volume sold, and not on maximum unit mark-up.

The financial institutions present a major barrier to scale-up. They are hesitant to provide mortgages to the housing beneficiaries, and resist providing loans to homeowners based on the value of the government housing subsidy. The financial institutions also follow a 'business as usual' approach, and are reticent to providing bridging financing to SMMEs and contractors building in the subsidy market. Some banks have extended mortgages to some segments of the low income market, however this was done primarily because foreign governments and NGOs provided financial guarantees. Thus, in doing so, the banks incurred essentially no risk. The financial institutions must be motivated to be more creative in supporting this program.

4.2.2.4 Construction labour costs

The cost of labour is a major consideration. These groups while also needing affordable homes can request rates that could severely impact the size of the structure. After building supplies and materials, labour is the next highest cost of the top structure. Labour rates follow supply and demand trends - if there are several projects in a given community or local area, skilled labour will move to the highest bidder; and conversely, if there is a lack of employment opportunities, labour prices drop.

In Kutlwanong, PEER Africa determined what the labour rates should be in order to produce the home for the subsidy amount. Commonly accepted practices of project management, and pricing of labour, materials, and supplies were used to accomplish this. Based on this, arrangements were worked out with the builders where they were paid for the number of houses built, the number of bricks laid, the number of roofs put on, etc. In other words, the building of the house was divided into incremental, component parts. Community workers and outside craftsmen essentially contracted with PEER to perform work on-site, and were paid by the job, not by the hour.

It has been shown that this approach to project implementation has the ability to promote rapid scale-up, enhance capacity building, and stimulate the development of SMMEs. The builders are given incentives to get the job done. The faster they are able to work, the more they get paid in a given amount of time. These builders have gradually emerged as SMMEs in Kutlwanong. The implementation of the franchise programme will allow scale-up to occur rapidly. The franchisee is familiar with the political systems, the community, running a business and managing construction. The ability to take on multiple, large projects will increase profitability and function as a major incentive to the franchise holder.

4.2.2.5 Situational and transport costs

Another barrier to scale-up is the cost of transportation of goods. This cost is often overlooked or not considered when projects are being planned. While one may be able to negotiate very favourable pricing of goods and services to build the houses, transportation costs tend not to be negotiable, and are often excessive. Thus, for materials not locally produced, one should expect higher costs. And in South Africa, many of the communities needing housing are situated in remote, rural areas where transport costs of building materials will be high. One method of addressing high transport costs is maximise the use of local, indigenous materials. Another option is to evaluate the potential for portable manufacturing of the bulky and heavy components of house construction, enabling on-site fabrication of materials. As with the cost of labour, the South African government will have to address the issue of transportation costs. This issue is a national one, and is not something that a builder or developer can address.

4.2.3 Scaling-up to meet the demand in townships

While it is recognised that the life-cycle of a community can be hundreds of years, the community of Kutlwanong intends to develop a community of 2000 homes over a two year period. The stated goal of the community is to be energy capital of South Africa. They desire to be a showcase for demonstrating state-of-the-art technology in energy-efficient, affordable homes. Thus, the project team is openly receptive to accommodating changes to the home design. However, new ideas must not inhibit delivery process, and must be piloted to insure acceptability before the changes are openly offered to the community. Many of these options are offered as "add ons" to the original house which does have cost constraints.

Changes that have already occurred are the availability of three different roof designs, different colour bricks for the houses, and the availability of compact florescent lamps. The roof designs came about because of the need to lower the cost of the structure due to increases in material cost, while trying to insure adequate ventilation. PEER Africa performed a car-

carbon monoxide study in the tin shacks in Kutlwanong this past winter, and confirmed that many of the stoves used for space heating and cooking were emitting dangerous to lethal levels of carbon monoxide. The intervention procedures to mitigate this problem will be discussed elsewhere, however, the need to ensure an appropriate level of ventilation in the ECOTM home is being met through new roof designs.

Another aspect of the house which has strong social and solar implications is the placement of windows. By the principles of passive solar design, large windows should be placed on the north side of the house to enhance solar gains during the winter months. However, in Kutlwanong the land plots have already been laid-out, and in some instances, these large windows require placement in the back of the home. Situations like this will routinely occur in 'brownfield' projects (construction on existing developed site), where streets are laid out sub-optimally for passive solar homes. A further issue complicating this matter which affects houses with the large windows in the back of the house is that the home-owners typically retain the shack in the backyard, which can create a shadow effect and doesn't provide an aesthetic view from inside the house. The shacks are retained to be used as additional living space or to rent out. Further, the loss of the large windows on the front of the house lessens its aesthetic appeal from the street, and therefore its social acceptability. Some homeowners were firmly against the large windows being in the back of the home, and design changes had to be made to accommodate their demands. However, PEER is now investigating alternative means to deal with this issue, such as putting translucent fibreglass in the back of the house at the roof line.

In Kutlwanong, PEER Africa has introduced solar-powered thermal water heating in the community. Two units are being installed, one on the demonstration house and the other unit will be installed on one of the experimental homes. PEER will also be introducing the use of LPG stoves in the next phase of the project which is the building of the next 500 homes.

The general problems with existing housing programmes appear to be the lack of up front planning, availability of skilled technicians and no desire to look for innovative solutions in meeting the needs of the people in all aspects of community planning and development - sustainability, affordability, acceptability, provision of healthy and safe living environments, energy efficiency and independence, economic development, capacity building, etc.. Further, few developers/builders work with suppliers to obtain more reasonably priced construction materials and supplies through bulk procurement and negotiation. The net result are small houses that are only a marginal improvement over the existing family's shack. The current practice of paying moderately discounted retail prices for materials with limited competition from builders, means that the available subsidy funds are not optimally utilised for these low-income communities.

4.3 The local industrial park concept and scale-up

The South African Department of Trade and Industry (DTI) is working with PEER Africa at the community level to promote local manufacturing of building materials. In both Kutlwanong and a project PEER is starting near Cape Town in an area called Guguletu, the DTI has been actively working to stimulate local manufacturing, and economic activity, particularly at the materials supplier level. By locating manufacturing and the supplies of good and services in these areas, the DTI is putting revenue and jobs close to the areas where they are most needed. The ability to concentrate the providers of goods and services in a central location also helps to foster good management practices, customer service, and the provision of high quality goods and services. It is envisioned that the local industrial park (LIP) will provide one-stop-shop advice on preferred building materials and construction methods.

The DTI has stated that the LIP will focus on those practices that promote the use of state-of-the-art residential building technology and energy efficient and environmental appliances and products. Working with local SMMEs and established manufacturers, the DTI seeks to

create LIPs to meet productivity needs in close proximity to the housing delivery projects. The DTI has several programmes at its disposal to put incentives in place for the manufacturers. Through the provision of low-cost capital or tax incentives, the DTI intends to encourage businesses to locate in target communities. In order for a company to qualify for these incentive schemes, it must focus on human resource development; job creation and local manufacturing.

In February 1997 the US-RSA Gore-Mbeki Binational Commission (BNC) met in Cape Town. As part of this event, the US Department of Energy requested that PEER Africa build two demonstration ECOTM homes in the Guguletu Township. These homes were built, and PEER is now in discussion with the community about designing a housing delivery programme in Guguletu.

5. Promoting Energy Efficient Housing in South Africa

The Kutlwanong Housing Project has identified several key barriers and areas of uncertainty which may negatively affect the scaling up of energy efficient housing in South Africa. The following recommendations address these barriers and uncertainties, and highlight some of the positive initiatives which are getting underway.

5.1 Establish a task team on environmentally sound housing

As energy efficient housing is a cross-cutting issue impacting on a wide range of sectors including energy, housing, health and environment, a successful national programme for low-cost energy efficient housing requires a co-ordinated effort from government. The Department of Housing is currently taking a lead role in establishing the task team, which will consist of the Departments of Minerals and Energy, Environmental Affairs and Tourism and Water Affairs and Forestry. The Task Team will consult with other Departments such as those of Constitutional Affairs, Health and Trade & Industry, as well as relevant stakeholders on specific issues. The principle aim of the Task Team would be to jointly pursue the promotion of environmentally sound low-cost housing.

The draft materials on the three focal areas of the Task Team include: policy development, awareness and training, and market support. Policy development activities would include:

- Developing a policy framework which will support and enhance the construction of environmentally sound, thermally efficient homes;
- Drafting policies which establish minimum standards for thermal performance of low-cost dwellings; and
- Promoting policies and incentives to encourage a competitive materials supply market and the development of energy efficient and environmentally sound technologies.

Awareness and training activities would include:

- Developing outreach materials and conduct presentations creating awareness of thermal efficiency and environmentally sound practises;
- Creating and conducting training seminars for builders and town planners; and
- Establishing a support network of experts who can consult on projects and provide the technical expertise to facilitate the construction of thermally efficient homes and environmentally sound communities.

Market support activities would include:

- Developing programmes to encourage builders and materials suppliers to construct thermally efficient homes;
- Initiating demonstration pilot projects; and
- Creating a network of manufacturers and project developers to expand the market and technologies of thermally efficient homes and environmentally sound communities.

5.2 Stop municipal charges for site and services

For most subsidised low-cost housing projects in South Africa, the charges for land and service infrastructure are a major component of the total construction cost. The municipality

requires that the housing beneficiaries pay for the capital cost of site and servicing up front. In many cases, the municipal charge represents an abuse of the subsidy system, as there exists a lack of transparency on the costs and standards of the service infrastructure.

The practise of charging for services in an upfront lump sum is uniquely applied to the historically disadvantaged communities, as the municipality recovers its revenue on similar investments in other areas over several years through rates and taxes. This practise of upfront charging for site and services should be stopped, and all South African citizens should be allowed to pay for these services through the local tax structure. Otherwise, less capital is available for the top structure, and smaller, inferior quality homes are provided to the community. And the rationale behind the municipality charging for the land is still not clear because ownership of the land before the Government of National Unity had not rested with the municipality. These questions are especially significant where people have been living on the land for many years, and now a formal house is being built they are expected to pay for the land.

5.3 Bulk pricing agreements for low-cost housing projects

The South African Department of Trade and Industry has been working with large national building suppliers and have set up master purchase agreements with a network of suppliers throughout the country. The DTI has been successful in working out national pricing agreements with several of the large building materials suppliers, including Corral Brick, Sagex, BP Gypsum, Iscor, SA Gypsum and several other smaller, local manufacturers. These agreements make special pricing for materials and supplies to builders operating in the subsidy market. The DTI should motivate builders to become a part of these national RDP agreements.

5.4 Pursue additional sources of finance

The government should play a supporting role to assist developers who are pursuing top-up finance from sources outside of existing housing finance channels (that is, the housing subsidy and financial lending institutions) for the specific purpose of covering the incremental costs of energy efficiency investments. Possible sources of finance include international funding organisations, such as the Global Environmental Facility (GEF), and foreign investment under the guise of Activities Implemented Jointly/Joint Implementation (AIJ/JI). GEF provides dedicated grants and low-interest loans to so-called developing countries who have ratified the United Nations Framework Convention on Climate Change (UNFCCC) to cover the additional costs of investments which have global environmental benefits, but have not been proven or demonstrated sufficiently to break down barriers to implementation. AIJ/JI refers to the process where the government of one country or a private enterprise in that country invests in measures, projects or programmes which result in greenhouse gas (GHG) emissions reduction or GHG sink enhancement in another country.

5.5 National policy interventions for a paradigm shift

The government should set policy to encourage energy efficiency and give incentives to bring developers and housing delivery organisations on board. One possibility would be to assess the subsidy scheme, and making provision for a special subsidy grant to those houses which achieve a minimum standard of energy performance. Precedent exists for such a departure. To encourage well-located low-cost housing, the subsidy makes provision for an additional grant of up to 15% of the maximum subsidy for housing which is located close to economic, educational, recreational and cultural opportunities.

5.6 Revise community master plan guidelines

Planning guidelines should be revised and new guidelines developed for 'Greenfield' projects which detail the specific requirements for master planning based on passive solar de-

sign. For example, layout the land plots to allow for correct solar orientation of the dwellings. Further, sustainable transport issues can be addressed through careful planning of the transport networks, and making provisions for pedestrians, bicycles and other modes of transport.

5.7 Construct demonstration homes

The construction of demonstration homes in small communities in key climatic zones of South Africa should be pursued as a mechanism to increase awareness in communities, municipalities and national government.

5.8 Develop resource materials

While the DME has recently developed material outlining the principles of passive thermal design, this information is of a technical nature, and is not readily understood by many housing delivery groups in South Africa. This represents a major information barrier to housing deliverers who find it difficult to translate knowledge of the broad principles of energy-efficient housing into practical design. To take advantage of the opportunity presented by the mass housing programme, it is imperative that these guidelines are negotiated and established as soon as possible. The success of these guidelines will depend on their usefulness as a practical tool and their dissemination to key housing stakeholders. The government should also review international experience in countries like Sweden, Denmark, The Netherlands, Canada and the USA, and adapt the lessons learned from similar programmes in these and other countries to South African conditions.

5.9 Promote education and awareness

There is a great need for education and capacity building around the subject of thermally efficient homes. The National Lotteries Commission of the United Kingdom has supported a programme in South Africa called "Energy Advisors" which is about to get started. This project will identify and train individuals from the historically disadvantaged communities in the principles of energy efficient and environmentally sound house design. The grant from the Lotteries Commission will pay the salaries of these individuals for three years, who will be working with housing delivery organisations to promote energy efficient, passive solar design. It is hoped that this programme will be expanded by the South African government and other motivated donors.

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U.S. Initiative on Joint Implementation

Reducing Greenhouse Gas Emissions Through International Partnerships

Located at:

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1000 Independence Avenue, SW
Washington, DC 20585 USA

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FOR IMMEDIATE RELEASE

ECO-HOMES PROJECT WOULD REDUCE EMISSIONS, RAISE HOUSING STANDARDS IN SOUTH AFRICA

Washington, D.C., July 22, 1998 - A proposed project to construct energy-efficient Eco-Homes in the community of Guguletu, Republic of South Africa, was chosen this month for inclusion in the U.S. Initiative on Joint Implementation (USIJI) program. The project would improve housing standards in the region with housing designs that would also keep greenhouse gas emissions to a minimum.

The Eco-Homes in Guguletu would minimize emissions through the use of passive solar construction, which can decrease a home's space-heating requirements by 50-70 percent. Other environmental benefits would include a reduction in the use of kerosene stoves, resulting in an abatement of local air pollution and improved indoor air quality. By providing training for members of the community in each phase of the construction, the project would also provide economic benefits through capacity building and technology transfer.

Housing expansion is a key component of the U.S.-South African Binational Commission headed by Vice President Al Gore and South African Vice President Thabo Mbeki. The Eco-Homes project would provide for the construction of up to 6,000 houses with energy-efficient features, helping to fulfill the Commission's efforts to design and build energy-efficient homes instead of standard low-cost houses that are subsidized by the Mandela Administration's Reconstruction and Development Program. The project would also contribute to President Mandela's pledge to raise living standards by providing an additional 1 million homes in South Africa by the year 2000.

The U.S. Initiative on Joint Implementation, part of the Clinton Administration's Climate Change Action Plan, encourages U.S. businesses and non-governmental organizations to voluntarily use their resources and innovative technologies and practices to reduce greenhouse gas emissions and promote sustainable development worldwide. Voluntary international partnerships offer the potential to achieve greater and more cost-efficient emission reductions worldwide than would be possible in each country alone.

The USIJI now includes 31 projects in 13 countries, representing a diversity of technologies that range from energy-efficient homes to power plant conversions. The projects are reviewed and selected by an evaluation panel composed of senior representatives from eight federal agencies.

The partners for the proposed Eco-Homes project: The International Institute for Energy Conservation of Washington, D.C.; PEER Consultants, P.C., of Maryland; and the Community of Guguletu, Republic of South Africa.

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For more information, media may contact Amber Jones at the Department of Energy, 202-586-5806, or Luke Hester at the Environmental Protection Agency, 202-260-1383. Businesses and other organizations may contact USIJI at 202-586-3288.

Supporting the Principles and Objectives of the Framework Convention on Climate Change

Phone: 202-586-3288

Fax: 202-586-3485 or 586-3486

U.S. Initiative on Joint Implementation

USII
PO-6, Room GP-196
1000 Independence Avenue, SW
Washington, DC 20535 USA

July 28, 1998

Mr. Russell Sturm
International Institute for Energy Conservation
750 First Street, N.E.
Suite 940
Washington, DC 20002

Dear Mr. Sturm:

On behalf of the U.S. Initiative on Joint Implementation's (USII's) Evaluation Panel, I want to congratulate you on your project's acceptance into USII. While reviewing the proposals submitted under this round of solicitations, the USII Evaluation Panel was looking for projects which will help USII expand its portfolio of interesting, quality projects that will produce real, measurable reductions of greenhouse gas emissions. We are proud to include your project in this portfolio. Thank you for your considerable effort and careful thought in developing this project proposal.

Your proposal *Housing For a Sustainable South Africa: The Guguletu Eco-Homes Project*, was accepted because the USII Evaluation Panel found it meets the purpose and spirit of USII, in addition to the specific criteria set forth in the USII Groundrules (Federal Register, June 1, 1994). I would like to emphasize, however, that there remains certain information which IIEC is required to furnish to the USII Secretariat and/or update annually. Additionally, there are areas of concern raised by the USII Evaluation Panel. The USII Secretariat will work with you as you implement your project. These areas of concern include:

- 1) Greenhouse Gas (GHG) Emissions Estimates: The emissions projections included in the project proposal were not accepted when the project itself is accepted into USII. The USII Secretariat, if requested, will work with IIEC to both improve the methodologies used for estimating GHGs in both the reference and project cases and work with you to improve the resulting estimates.
- 2) Monitoring and Verification: It will be necessary to establish detailed project monitoring and verification plan for submission to the USII Secretariat. This plan needs to identify who will monitor and verify GHG reduction activities and variables over the lifetime of the project. This plan should clearly demonstrate that there are increased GHG benefits. The USII Secretariat is interested in working with you to establish a credible monitoring and verification plan.

3) Annual Reporting: The USDI Groundrules require that participants report annually in accordance with guidelines developed by the Evaluation Panel. The USDI Secretariat has developed a project report form, that will be sent to you by mail, which is consistent with the Uniform Reporting Format formally adopted by the UNFCCC in March 1997.

The proposal manager, Harvey Major, (telephone: 202-586-3054, fax: 202-586-3485/86) is available to discuss your project. Please feel free to contact the USDI Secretariat with any concerns, questions or needs you may have.

The USDI Secretariat press release announcing your proposal's acceptance is attached, for your information.

Again, congratulations on your acceptance into this unique partnership for interested parties who join in a spirit of international cooperation to address global climate concerns. We look forward to working with you as your project is implemented. Please contact me at 202-586-3003 if you have any comments or questions regarding USDI.

Sincerely,

Robert K. Dixon, Ph.D.
Director

cc: Dr. Lilia Abron, President/PEER Consultants, P.C.
Bulelwa Belu-Tomi, Community of Guguletu, Republic of South Africa

MINISTRY OF TRADE AND INDUSTRY

UMNYANGO WEZOHWEBO NEZIMBONI • MINISTERIE VAN HANDEL EN NYWERHEID
LEFAPHA LA TSA DIKGWEBO LE MADIRELO

4 August 1998

Mr Douglas Guy
Operations Manager
PEER Africa (Pty) Ltd
P O Box 4030
RANDBURG
2125

Dear Mr Guy

Deputy Minister Phumzile Mlambo-Ngcuka would like to thank and congratulate you for the inclusion of Guguletu houses in USIJL.

Could you please advise us on what the next move should be on our part.

Kind regards

JUDY ABRAHAMS
Personal Assistant to the Deputy Minister

cc Mr Khanya Motshabi
Ms Bulelwa Belu-Toni