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Responding to Climate Change, Generating Community Benefits

A Review of Community Initiatives supported by the Global Environment Facility's Small Grants Programme 1992-2003

SGP The GEF Small Grants Programme

on the front cover:

Involvement of both men and women in leadership of SGP supported activities is emphasized. A lady committee member conducting a meeting at Mbuiru village at the Tungu-Kabiri micro-hydro power scheme, Kenya

Battery charging is one of the services provided by SGP supported community renewable energy schemes. A man taking a battery for charging in Polócon village, Philippines.

A teacher conducting training in a school in El Limón, Dominican Republic. The electricity to run the computers is from the El Limón community micro-hydro power scheme supported by SGP.

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November 2003

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A mini-grid (electricity) distribution lines of the El Limón village, in the Dominican republic.

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Acknowledgements

This publication represents more than a decade of "learning by doing". Over 4,000 projects have been supported by the Small Grants Programme (SGP) of the Global Environment Facility (GEF) since 1992. Approximately 20 per cent of these have been focused on climate change.

Prepared by the SGP Central Programme Management Team, this publication summarizes the findings of the SGP climate change portfolio review carried out by Esther Ebrahimian, Stephen Gitonga and Carmen Tavera in early 2003.

Grounded in extensive consultations with SGP grantees and country programme teams responsible for the implementation of SGP supported projects, it examines the current status of the portfolio, emerging trends and key lessons. Grantees contributed detailed case studies that provided the core body of information and experiences contained in the publication. Esther Ebrahimian compiled the case studies summarized in this text. Country programme teams assisted in reviewing the numerous drafts of the climate change portfolio review and the various drafts of this publication, and provided images. Warm thanks are extended to all for investing their time and energy in this process. Stephen Gitonga, SGP's Climate Change Programme Officer, coordinated the portfolio review and drafted this publication.

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Foreword

The theme of this special report, **Responding to Climate Change, Generating Community Benefits**, is fundamental to the GEF goal of safeguarding the global environment while creating opportunities and livelihoods for the world's poor.

The irony of the climate change phenomenon is that, historically, industrialized nations are responsible for almost three fourths of carbon dioxide emissions worldwide. Yet it is the poor people in developing countries who will most likely feel the pain.

An increase of less than 2 degrees Celsius in the average global temperature in the next 100 years would bring some benefits to technically advanced countries with temperate climates (milder winters, longer growing seasons), but the ability to deal with warming depends heavily on economic resources and access to technology. In developing countries, even a modest warming could mean severe flooding of coastal areas, an increase in storms and heavy rains in some regions, and more rapid desertification in others—all of which have enormous implications for natural ecosystems, water resources, and food production. Although climate change is global in scope, scientists have warned that it could have a devastating effect on the well-being of people already living on the edge of poverty, those with the fewest resources to cope.

As the financial mechanism of the United Nations Framework Convention on Climate Change (UNFCCC), the GEF has allocated more than US $1.6 billion to over 400 climate change projects and enabling activities—from China's ambitious programme to expand the use of renewable energy throughout the country, to the Caribbean project to help small island states develop technical and institutional response mechanisms for adaptation to global climate change.

The GEF also addresses climate change issues through GEF's Small Grants Programme. The genius of SGP is that it touches the lives of thousands of ordinary people—the non-governmental organizations (NGO), community groups, small entrepreneurs, and other leaders in local communities—who need the most assistance to respond to climate change. We are proud that the GEF has committed $117.4 million in small grants to promote locally appropriate solutions to this and other global environmental concerns. Through the UNDP, more than 4,000 projects are being implemented in 63 countries, leveraging an additional $65.6 million from other partners. As the climate case studies on the following pages show, SGP is demonstrably helping citizens and communities around the world prepare to adapt to the consequences of climate change and mitigate its deleterious effects.

Len Good
Chief Executive Officer and Chairman
Global Environment Facility

Preface

Poor communities depend solely on available local natural resources and ecosystems for their survival. Climate change is likely to be catastrophic for them. Already struggling in the face of deep poverty and without access to basic services, they are the most vulnerable to extreme weather events and climatic variation.

Mention the need to act on global climate change to poor communities and you might receive stares of incomprehension. Yet, collectively, communities can be the most important participants in protecting the global environment. If the link between protecting the global environment and generating local benefits is made clear and tangible, then communities can be actively engaged to cope with the challenges of climate change.

Operational since 1992, the GEF Small Grants Programme (SGP) has disbursed over 790 small grants totaling US $16.6 million with $13.3 million leveraged in co-financing to strengthen the capacities of local communities in developing countries to respond to climate change concerns while enhancing local well-being and livelihoods. The grants are channeled directly to non-governmental and community-based organizations in developing countries. This publication captures the unique and valuable experiences emerging from these efforts.

Communities supported by SGP grants have pioneered a wide range of innovative and homegrown technologies, activities and approaches. Utilizing smokeless stoves; taking advantage of solar energy for drying herbs and pumping water; adopting biogas technology; building micro-hydropower plants that depend on sustainable watershed management; developing the capacities of energy micro-enterprises; improving decentralized power policy and legislation; commercializing rural solar electrification; and inventing more efficient and non-polluting brick kilns are just a few examples. As far as possible, obstacles have been turned into opportunities.

The lesson is clear. Communities in developing countries can act on global climate change concerns through the application of local solutions that generate local benefits. By sharing experiences and lessons, SGP hopes to enhance the contribution that communities, particularly in the world's poorest countries, can make to this effort.

Their—and everyone's—future survival depends on it.

Delfin Ganapin
Global Manager
GEF Small Grants Programme

Acronyms and abbreviations

AC	alternating current
ADESOL	Asociación para el Desarrollo de Energía Solar (Association for the Development of Solar Energy), Dominican Republic
AEPC	Alternative Energy Promotion Centre, Nepal
ASEAN	Association of Southeast Asian Nations
BACIP	Building and Construction Improvement Programme, Pakistan
BUN	Biomass Users Network Inc., Central America
CAFOD	Catholic Fund for Overseas Development
CBO	community-based organisation
CETF	Community Environment Trust Fund, Pakistan
CIDA	Canadian International Development Agency
CIS	Commonwealth of Independent States
COP	Conference of Parties
CPMT	Central Programme Management Team
CPS	Country Programme Strategy
DAC	Development Assistance Committee
DC	direct current
EEC	Energy Efficiency Center, Albania
EET	energy efficient technology
EU	European Union
FSP	GEF full-sized project
GEF	Global Environment Facility
GIDES	Giruwapaththu Development Square, Sri Lanka
GHG	greenhouse gases
Gt	giga tonnes
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Department for Technical Coorporation)
HAA	Housing Advisory Agency, Lithuania
HELP™	Home Employment Lighting Package™, Nepal
HLF	Himalayan Light Foundation, Nepal
HOA	Homeowner Association
IDEA	Integrated Development Association, Sri Lanka
IISD	International Institute for Sustainable Development
ISE	informal sector enterprise
IPCC	Intergovernmental Panel on Climate Change
IPP	independent power producer
ISAD	Institute for Sustainable Agriculture Development
ITDG	Intermediate Technology Development Group
KW	kilowatt
KWh	kilowatt hours
LIDEMA	Liga del Medio Ambiente, Bolivia
MDGs[1]	Millennium Development Goals
MPRO	Municipal Gardens Company, Poland

1 See http://www.un.org/millenniumgoals/.

MSP	GEF medium-sized project
NC	National Coordinator
NGO	non-governmental organisation
NSC	National Steering Committee
OECD	Organization for Economic Cooperation and Development
OIC	Opportunities Industrialization Center, Côte D'Ivoire
ONE	Office of National Electrification, Morocco
OP	operational programme
PPLH	Seloliman Center for Environmental Learning, Indonesia
PRONATURA	Fondo Pro Naturaleza Inc., Dominican Republic
PV	photovoltaic
(RELIEF™)	Revolving Electrification and Income Enterprise Fund, Nepal
RET	renewable energy technology
RETAP	Renewable Energy Technology Assistance Programme, Kenya
SGP	GEF Small Grants Programme
SME	small to medium enterprise
SO-BASEC	Solar-Based Electrification Concept, Dominican Republic
SOVED	Solar Village Electrification Demonstration Project, Nepal
STAP	Scientific and Technical Avisory Panel, GEF
SURF	Sub-Regional Resource Facility, UNDP
SURUDE	Foundation for Sustainable Rural Development, Tanzania
TTSA	Thermal Technology and Science Association, Viet Nam
UAWC	Union of Agricultural Work Committees, Occupied Palestinian Territories
UN	United Nations
UNDP	United Nations Development Progamme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UoM	University of Mauritius
US	United States
W	watt
$	All $ amounts cited in the text are US dollars

Definitions

Adaptation
Adaptation to climate change refers to the process through which people reduce the adverse effects of climate on their health and well-being, and take advantage of the opportunities that their climatic environment provides.[2]

Barriers
Barriers include all social, cultural, economic, institutional and political aspects that hinder sustainable access to - and adoption of- renewable energy technologies or energy efficiency benefits or practices.

Community
The term "community" in the SGP context of climate change abatement refers to a group of individuals who come together to address common life and livelihood needs that can be met by the provision of energy services. In some countries, a group of individuals is defined as a community by their geographical proximity. In others, a community is defined by its socio-economic context, which may be urban, peri-urban or rural. Local communities tend to have few or no modern energy services and where they do, they only have limited access. SGP engages with communities through the support of NGOs and community based organizations (CBOs)"

Climate change
Climate change, as defined by the UNFCCC, is a change of climate attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.[3]

Environment
The environment is the sum total of all surrounding conditions that influence the growth and development of living forms.

Ecosystem
An ecosystem is a functional unit in nature defined by the complex dynamic interaction of animals, plants and human communities and their non-living environment.

Energy efficiency
Energy efficiency refers to the use of less energy for delivering an energy service with similar outputs to a service provided through less efficient means.

Energy services
Energy services are the tangible or intangible life and livelihood needs met by energy (e.g. recreation, lighting, cooking, communications, transport and heating). In the SGP context, the choice of energy intervention or technology is driven by the need to respond to climate change.

Livelihood
A livelihood comprises people, their capabilities and their means of living, including food, income and assets.

2 Olmos, S (2001) Foundation Paper on Vulnerability and Adaptation to Climate Change: Concepts, Issues, Assessment Methods for the Climate Change Knowledge Network, hosted by IISD. See http://www.cckn.net/pdf/va_foundation_final.pdf\.
3 Source: www.UNFCCC.org/int.

Tangible assets are resources and stores, and intangible assets are claims and access. A livelihood is environmentally sustainable when it maintains or enhances the local and global assets in which livelihoods depend, and has net beneficial effects on other livelihoods. A livelihood is socially sustainable when it can cope with and recover from stress and shocks, and provide for future generations. (See footnote 5 for source).

Local benefits

Local benefits are life and livelihood benefits accrued by beneficiary communities over and above global environmental benefits in the region where an SGP project is implemented. These benefits can be both tangible and intangible.

Micro-hydropower

Any power scheme below 100 kilowatts (KW) is referred to in this publication as a micro-hydropower scheme. All community micro-hydropower schemes supported by SGP range from less than 1KW to 100KW.

Partnership

Partnership refers to the joint application and deployment of human, technical and/or financial resources for a common purpose. While the objectives of different partners in a partnership may be different, the goal is similar.

Renewable energy

Renewable energy refers to all energy derived from resources that are infinite, including biomass, solar, wind, among others.

Sustainable transport

Sustainable transport refers to all means, modes and practices of transport that are climate-friendly and contribute to climate change abatement.

Executive summary

This publication sets out the lessons and experiences that have emerged from SGP's portfolio of community-based climate change projects. It is based on the results of a decade of monitoring and evaluation work undertaken by SGP country programmes and projects at the community level and a recent review of SGP's climate change portfolio. These activities have enabled a clear understanding of the overall contribution of SGP to global climate change abatement while enhancing environmental and local benefits.

Climate change is one of five GEF focal areas implemented by SGP at the community level. Activities to date have influenced the lives of thousands of people. SGP focuses its support for community-led climate change projects on four areas:

1. Removing barriers to energy efficiency and energy conservation.
2. Promoting the adoption of renewable energy by removing barriers and reducing implementation costs.
3. Promoting environmentally sustainable transport.
4. Cross-cutting issues related to energy, climate change and integrated ecosystem management.

Based on an analysis of practice in SGP participating countries, each chapter offers a rich range of ideas and experiences to inform other community-level climate change projects. Chapter One introduces the GEF and SGP, placing climate change challenges in the context of internationally agreed environment goals and targets. Chapter Two examines the findings of the SGP climate change portfolio review, including project typologies and emerging trends, types of energy services provided by SGP projects and their impacts on different livelihood sectors, and barriers to climate change mitigation. Chapter Three explores the world of SGP in action, revealing the approaches, experiences and lessons of past and on-going projects. Chapter Four summarizes a set of lessons learned and Chapter Five concludes the publication with a look at the future of SGP and UNFCCC. Select projects are presented as case studies throughout the publication.

SGP hopes that the publication will interest everyone involved in community action for sustainable development. In practice, it will have a multiple audience including:

- Community groups and NGOs.
- Policy-makers and decision-takers concerned with sustainable development and environmental protection at all levels (local, sub-national, national and international).
- Private sector companies and associations wishing to contribute to sustainable local development while protecting the environment.
- United Nations (UN) agencies, multilateral development banks, development cooperation agencies and others concerned with helping countries to achieve the Millennium Development Goals (MDGs).
- Academics and students.

SGP hopes that you will find this publication interesting and useful and, as always, welcomes your feedback.

Community members inspect their biogas digester in Mali.

1.1 Background

Climate change is a global problem that affects us all. But communities in developing countries are likely to suffer most from the negative impacts of climate change[4]. Their lives and livelihoods[5] depend directly upon the fragile natural resources around them. The consequences of more frequent and more extreme weather events, rising sea levels and other climatic changes that damage and degrade these resources cannot be underestimated. They will be devastating.

Box 1. Economic impacts of climate change

Whereas 45 per cent of natural disaster losses between 1985 and 1999 took place in wealthy countries (those with annual per capita income of more than $9,360), these countries represent 57 per cent of the $984 billion in total economic losses and 92 per cent of the $178 billion in insured losses (Munich Re, 1999b). In contrast, 25 per cent of the economic losses and 65 per cent of the 587,000 deaths took place in the poorest countries (those with per capita income below $760).

Source: http://www.grida.no/climate/ipcc_tar/wg2/340.htm

With limited technological and financial capacity to anticipate and respond to the direct and indirect effects of climate change[6], yet dependent on climate sensitive sectors to meet their basic needs, communities must rely on their ability to adapt to constantly changing and challenging conditions.

Both human activities and natural processes induce climate change. Human activities deplete the ozone layer[7], emit greenhouse gases and reduce carbon sinks. The combined effect is global warming and, consequently, climate change. Slowing human induced climate change requires a multitude of actors to carry out a combination of interventions. These include:

- Reduce dependence on fossil fuels.
- Use available fuels more efficiently.
- Use more climate-friendly sources of energy.
- Improve the efficiency of energy technologies.
- Substitute ozone-depleting substances[8].
- Conserve carbon sinks.

4. Jarraud, M (2003) Climate change and global energy needs: A 21st century perspective, World Meteorological Organization in Renewable Energy 2003, World Renewable Energy Network (affiliated to UNESCO), Sovereign Publications Ltd., London.
5. The term 'sustainable livelihood' was first used as a development concept in the early 1990s. Chambers and Conway (1991) defined a sustainable livelihood as follows: A livelihood comprises people, their capabilities and their means of living, including food, income and assets. Tangible assets are resources and stores, and intangible assets are claims and access. A livelihood is environmentally sustainable when it maintains or enhances the local and global assets in which livelihoods depend, and has net beneficial effects on other livelihoods. A livelihood is socially sustainable when it can cope with and recover from stress and shocks, and provide for future generations. For more information, visit http://www.livelihoods.org.
6. Source: http://www.grida.no/climate/ipcc_tar/wg2/057.htm.
7. United Nations Environment Programme (1992) The Impact of Ozone Layer Depletion, UNEP/GEMS Environment Library Number 7, Nairobi.
8. Source: http://www.grida.no/soeno98/ozone/ecolefct.htm.

The UNFCCC[9] recognizes that the concerted efforts of nations are essential to slow climate change. While an estimated 1.6 billion people in developing countries do not have access to electricity, do not enjoy modern energy services[10] and do not emit large amounts of greenhouse gases (in stark contrast to communities in industrialized nations), their energy and development needs still need to be met. With technical and financial support, poor communities can play an important role in finding adequate responses to climate change and development challenges.

SGP climate change mitigation initiatives generally aim to sustain the use of basic assets (e.g. land or water) and/or catalyze alternative means of production. They are highly valued by communities because they reconcile environmental priorities with local needs and generate local benefits. While the contribution of a single community might be small in terms of global impact, it can contribute to the development of sustainable energy and development solutions that reduce greenhouse gas (GHG) emissions and protect local ecosystems. The cumulative effect of action at the community level is therefore significant. Community-driven climate change initiatives are a core element of the global campaign to reduce global GHG emissions.

1.2 About the Global Environment Facility

The GEF is an independent entity that unites 176 member governments—in partnership with international institutions, NGOs and the private sector—to address global environmental issues while supporting national sustainable development initiatives. In 12 years, the GEF has evolved from a pilot program to the largest single source of funding for the global environment.

Since its inception in 1991, the GEF has committed $4.5 billion in grants and leveraged $14.5 billion in cofinancing to support over 1,300 projects in more than 140 developing countries. SGP, implemented by the UNDP, has also provided more than 4,000 small grants directly to community groups and NGOs.

The GEF serves as the designated financial mechanism for the international conventions on biological diversity, climate change, persistent organic pollutants, and desertification. It also supports global agreements to protect the ozone layer and clean up international waters. GEF projects are implemented by UNDP, the United Nations Environment Programme (UNEP) and the World Bank. Seven other regional development banks and specialized UN agencies also help manage GEF projects.

As operator of the financial mechanism of the UNFCCC and the leading multilateral entity promoting energy efficiency and renewable energy technologies in developing countries, GEF manages a $10.6 billion climate portfolio that supports more than 400 projects and enabling activities.

The GEF's climate change activities focus on:

- Removing barriers to energy efficiency and energy conservation.
- Promoting the adoption of renewable energy by removing barriers and reducing implementation costs.
- Reducing the long-term costs of low greenhouse gas-emitting energy technologies.
- Supporting the development of sustainable transportation.

9. See http://unfccc.int/ for more details.
10. International Energy Agency (2002) World Energy Outlook 2002: Chapter 13, Energy and Poverty, Paris. See http://www.worldenergyoutlook.org/weo/pubs/weo2002/EnergyPoverty.pdf.

1.3 About the GEF Small Grants Programme [11]

Operational since 1992, SGP is a GEF programme. It complements the activities and scope of full and medium-sized GEF projects by disbursing grants directly to NGOs and CBOs in developing countries for initiatives that conserve and restore the natural environment while enhancing local well-being and livelihoods. The role of civil society in mitigating climate change and addressing other global environmental benefits was recognized at the inception of the GEF:

The involvement of non-governmental and local populations is critical to the success of GEF-funded projects. Individual NGOs, NGO networks and community groups can play an important role in ensuring that GEF projects are sensitive to the needs and concerns of the local populations. NGOs can also participate in implementing projects through the Small Grants Programme. [12]

Highly decentralized and demand-driven, SGP encourages maximum country and community-level ownership. Grants are screened, approved and disbursed at the national level by a voluntary national steering committee (NSC). The NSC typically comprises representatives from local NGOs, government, academia, UNDP and occasionally co-funding donors, indigenous peoples' organizations, the private sector and the media.

Box 2. Small grants, multiple impacts

Economically efficient, small grants feed directly into the hands of those who can best identify the needs and priorities of the community. Small enough to discourage misuse and avoid overwhelming a fragile society with new money, small grants provide important catalytic seed funding to enable communities and locally based NGOs to test what works for them, as well as what does not. The level of investment promotes trial and error, and encourages the organic development of partnerships, networks and coalitions by community members as they leverage the grant received.

Small, strategically targeted projects can contribute to solving global environmental problems whilst enhancing the livelihood security of local people. There is evidence that many of these projects deliver more favorable cost-benefit ratios than larger projects.

Source: GEF (2001) Second Overall Performance Study

National Coordinators (NC) are appointed to carry out day-to-day management of the programme and serve as secretary to the NSC. The NCs are responsible for reaching out to local NGOs and CBOs to inform them of the availability of grants and to encourage communities to send in proposals based on their ideas. Each SGP country programme is guided by a specific Country Programme Strategy (CPS), which details the scope of activities that can be funded by the country programme. The CPS is developed through a participatory process involving a wide range of local stakeholders to encourage local initiative and raise awareness about the mechanism.

The maximum size of an SGP grant is $50,000. Projects are therefore small and are meant to demonstrate innovative approaches to climate change mitigation at the community level. To achieve this, the process of project design includes all key stakeholders and partners, and focuses on capacity development through demonstration and training, awareness creation and dialogue. Complementary partnerships increase the reach, impact and sustainability of SGP's demonstration projects. Occasionally, projects supported by SGP at the community level are scaled up to become GEF medium-sized projects and can be implemented by any of the three GEF implementing agencies.

11. See http://www.undp.org/sgp for more information.
12. GEF (1992) The Pilot Phase and Beyond; GEF working paper series number 1, GEF, Washington D.C.

Since its inception, SGP has confronted very real challenges in working with communities to reconcile global environmental challenges with local community needs. SGP is convinced that channeling small amounts of catalytic funding directly to communities enables them to select and undertake those activities that make a significant difference in their lives and environment.

Looking back at our project experiences, I am encouraged by scenes of men and women and children coming together to address community problems; barren hills coming to life again with endemic tree species; and women and children fetching water from a tank filled by a solar-powered pump. While much still has to be done in terms of community empowerment and capacity to build on and sustain project gains, I am convinced that smallness pays great dividends—Ponciano L. Bennagen, Sentro Para sa Ganap na Pamayanan Inc., the Philippines

1.4 SGP activities related to climate change

Working with communities to respond to climate change while addressing their pressing development needs is a central element of SGP's activities. It is the means by which the GEF supports implementation of the UNFCCC at the community level. Over the past decade, SGP supported climate change activities have produced innovative approaches and experiences, which demonstrate community by community how to achieve development goals in a climate-friendly way.

SGP climate change projects are implemented according to the following operational programmes:

- Removing barriers to energy efficiency and energy conservation.
- Promoting the adoption of renewable energy by removing barriers and reducing implementation costs.
- Promoting environmentally sustainable transport.
- Cross-cutting issues related to energy, climate change and integrated ecosystem management.

The scope of SGP support to climate change activities does not include reduction of the long-term costs of low GHG emitting energy technologies.[13] Nor is SGP mandated to support projects relating to ozone layer depletion, which is addressed by the Montreal Protocol.[14]

1.5 The SGP climate change portfolio review

The data and facts contained in this publication have emerged from a systematic review of the SGP climate change portfolio, comprising the analysis of 655 past and present community-based projects[15] and the detailed profiling of 50 of these. The review was initiated to obtain a clear understanding of the overall global contribution of SGP to global climate change abatement[16] while enhancing environmental and local benefits. Initiated in mid-2002, a team systematically examined all activities carried out within the SGP climate change portfolio between 1992-2002 and extracted lessons and experiences.

The SGP global database served as the primary mechanism for collecting data and information about SGP projects for the portfolio review. Semi-annual reports and biennial programme reviews also provided important insights into project experiences, approaches and lessons. Grantees, SGP national coordinators and UNDP

13. GEF operational programme 7 aims to "reduce the long-term costs of low greenhouse gas-emitting energy technologies".
14. Montreal Protocol, officially the Protocol on Substances That Deplete the Ozone Layer, is a treaty signed on September 16, 1987, at Montreal by 25 nations; 184 nations (as of October 2003) are now parties to the accord. The protocol set limits on the production of chlorofluorocarbons (CFCs), halons, and related substances that release chlorine or bromine to the ozone layer of the atmosphere. See http://www.undp.org/seed/eap/montreal/ or http://www.unep.org/ozone/index-en.shtml.
15. The 655 projects were all those climate change projects detailed in the SGP global database at the time of the review.
16. The projects under review have been primarily mitigation projects and not adaptation projects.

country offices provided more details about specific projects and access to archived materials. Other information was obtained from evaluation reports, terminal reports, country programme and project reviews, thematic booklets and press articles. The results of the review include five regional review reports, 50 detailed project profiles and one consolidated report. Copies can be found at http://www.undp.org/sgp.

This publication summarizes and brings together the key elements of these outputs. It reveals a rich diversity of community initiatives designed to mitigate climate change while sustaining lives and livelihoods. Select experiences are presented as case studies.

With the support of SGP, Costa Rica's Sol de Vida Foundation has established a research centre to promote the different uses of solar energy. Solar creativity workshops have been organized so that families can sample food made in solar kitchens, exchange recipes, learn about technical issues such as photovoltaic cells and drip irrigation, and even introduce their children to solar-powered toys.

Chapter 2 The SGP climate change portfolio

This chapter examines the current structure and status of the SGP climate change portfolio, based on the findings of the recent portfolio review. It is broken into five sections detailing:

- Status and emerging trends.
- Project typologies.
- Types of energy services provided by SGP projects.
- Livelihood aspects benefiting from energy services provided by SGP projects.
- Removing barriers to climate change abatement.

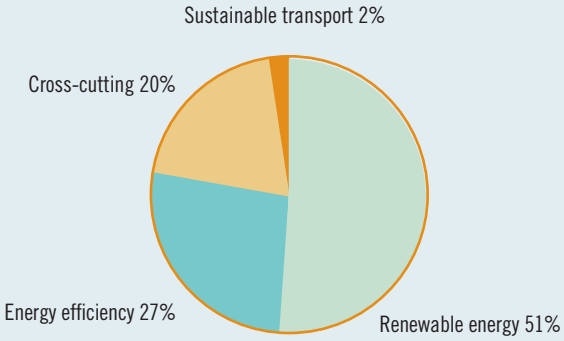
2.1 Status and emerging trends

At the time of the SGP climate change portfolio review (initiated mid-2002), SGP was supporting approximately 3,150 projects globally and the climate change portfolio represented about 20 per cent of this total or 655 projects[17].

SGP grants relating to climate change mitigation have supported projects with different objectives, including the promotion of renewable energy, energy efficiency and environmentally sustainable transport, as well as projects that address both climate change abatement and biodiversity conservation.

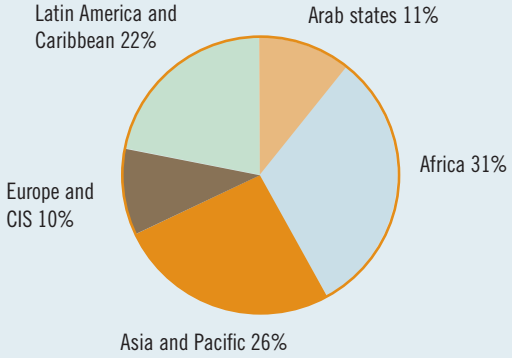
Figure 1 details the distribution of climate change projects by operational programme. The regional distribution of projects is shown in Figure 2[18].

Figure 1: SGP climate change projects by operational programmes (2002)



Source: 2002 SGP climate change portfolio review.

Figure 2: SGP climate change projects by region (2002)



Source: 2002 SGP climate change portfolio review.

The share of SGP climate change projects as a percentage of the total SGP grant portfolio has remained the same over the years. However, since 1999, the number of projects focused on energy efficiency projects has dropped from 45 per cent to the current 27 per cent while renewable energy technology projects have increased from 29 per cent to the current 51 per cent. This is a result of the availability and decreasing costs

17. The number of SGP projects in implementation is continually increasing as new projects are approved on a daily basis. At the time of writing (December 2003), SGP is supporting over 4,000 projects globally.

of renewable energy technologies in developing countries, among other reasons. SGP's focus on capacity development and awareness raising over the years has also greatly contributed to this trend.

Another key trend of the portfolio is diversification. For example, in 1995, in the Africa region, 45 per cent of all climate change projects were related to energy efficiency, mostly supporting the dissemination of improved cook stoves. In 2003, the portfolio now has over 58 per cent of projects related to renewable energy (the share of energy efficiency projects has dropped to 26 per cent) including a wide range of technologies, such as wind, micro-hydro, solar and modern biomass. The energy services provided by the various technologies have also diversified. Increasingly, projects are geared toward supplying energy to income generating activities—such as agro-processing and small scale-enterprises—rather than toward meeting other non-productive end-uses such as household lighting, heating and cooking. This trend is important because it improves the likelihood that projects will be sustained.

2.2 Project typologies

This section provides an overview of the types of interventions within each operational programme. The choice of projects in each country is influenced by the Country Programme Strategy (CPS) which helps to match specific community needs with GEF objectives.

2.2.1 Renewable energy

Existing projects within the renewable energy operational programme fall into two general categories as shown in Table 1:

Table 1. General categories of existing SGP renewable energy projects

Project category	Characteristics	Linkages to climate change
Renewable Energy Technology (RET)	Technologies in different forms, e.g. solar, micro-hydro, wind, use of modern biomass (gasification, biogas) and geothermal	Reduces demand for conventional fuels, e.g. diesel, kerosene or fuel wood
Alternative fuels	Biofuel or biodiesel activities, e.g. jatropha oil and rapeseed derived biofuel	Reduces demand for fossil fuels, e.g. kerosene and diesel
Waste recycling and re-use	Waste-to-energy type of activities, e.g. briquettes, biogas	Reduces the possibility of production of methane associated with decomposition. Provides alternative fuel

Source: analysis of SGP climate change projects from 1992 to 2002

The overall trend is that renewable energy projects managed by NGOs and CBOs are becoming increasingly important instruments for community-level response to climate change.

We decided to create Sol de Vida organization because we had this idea of starting Sun Feasts (Fiestas del Sol) to show people what you could do with a sun-powered kitchen. Firewood is still used here in Costa Rica in most households, threatening the last remains of dry tropical forest on the continent. Gas, wood and electric kitchens contribute to the greenhouse effect. Yet solar energy is free. One day we placed the kitchens outside and started cooking. We invited other women and groups of people to taste what we were making. Our idea was not just selling them a kitchen; we wanted to work with groups, to organize workshops, do things with the communities. Now the Sun Feasts are traditional, and other ideas have taken shape. The Solar Creativity Workshops invite children, families and groups to play with solar-powered toys, taste food cooked in a solar kitchen, learn about photovoltaic (PV) cells and drip irrigation. Banquets and recipe contests mark the seasons—Fátima Montealegre, NGO Sol de Vida, Costa Rica[19]

2.2.2 Energy efficiency

Existing projects under the energy efficiency operational programme fall into four general categories as shown in Table 2:

Table 2. General categories of existing SGP energy efficiency projects

Project category	Characteristics	Linkages to climate change
Energy Efficient Technology	Improved stoves, energy efficient micro-enterprises/industry, efficient kilns, crematoria, etc.	Reduces demand for fossil fuels and unsustainable use of fuelwood. Reduce general energy demand and use of biomass resources
Building and housing	Efficient building materials. Improved efficiency in house heating	Reduces the overall demand for fossil fuels for heating purposes
Energy auditing	Energy audits in enterprises or industry	Improves efficiency in enterprises/industry and reduces demand for fossil fuels

Source: analysis of SGP climate change projects from 1992 to 2002

2.2.3 Sustainable transport

Existing SGP sustainable transport projects fall into four general categories as shown in Table 3:

Table 3. General categories of existing projects on environmentally sustainable transport

Project category	Characteristics	Linkages to climate change
Transport infrastructure	Bicycle routes and tracks	Reduces the use of motorized transport
Public transport[20] centralization	Community bus scheme (pilot case)	Reduces the number of vehicles being used for a single purpose
Transport fuel shift[21]	Shift from diesel to biofuel	More mileage covered thus less pollution per kilometer covered. Biodiesel reduces demand for diesel
Monitoring of emissions.	Raising awareness of general public about vehicular emissions	Awareness raising, lobbying and capacity development

Source: analysis of SGP climate change projects from 1992 to 2002

19. From an article by Yanina Rovinski for SGP Costa Rica titled For Fátima and her friends, liberation came from the solar kitchen.
20. GEF Operational Programme 11 guidelines note on page 4 that "cost-effective measures that merely increase the efficiency of current systems that continue to be based on fossil-fuels should be justified as short-term response measures projects". See http://www.thegef.org
21. Idem.

2.2.4 Projects with cross-cutting aspects relating to climate change and biodiversity

A number of projects were implemented during the pilot phase of SGP (1992-1995) focusing on cross-cutting objectives related to climate change and integrated ecosystem management. Such projects fall into two categories as shown in Table 4:

Table 4. General categories of existing projects with cross-cutting aspects related to biodiversity

Project category	Characteristics	Linkages to climate change
Tree planting, fuel wood plantations and land management	Woodlots, fuel wood gardening (urban, social and farm forestry)	Increases carbon sinks and build biomass energy stocks
Waste management	Municipal waste management. Production of manure	Reduces the possibility of production of methane associated with decomposition. Enhabces possi bility to provide alternative fuel

Source: analysis of SGP climate change projects from 1992 to 2002

2.3 Types of energy services provided by SGP projects

Table 5 shows the percentage of SGP climate change projects providing specific types of energy services in different regions around the world. Each region has developed a unique set of energy services for different end-uses. This can be explained by the diverse socio-economic and environmental conditions found in each region, which strongly influence what energy services a community needs. For example, in Africa, energy for irrigation and water pumping account for 19 per cent of the region's climate change portfolio, while in Europe and the CIS 61 per cent of projects address the need for water and home heating.

The energy services column shows the different technology preferences and trends emerging in each region to meet energy demands. As SGP projects are demand-driven, the table reflects the nature of community demand for energy services. Approximately 50 per cent of SGP projects adopt renewable energy as the means to mitigate climate change.

Table 5. Energy services of SGP climate change projects per region

End use (energy service)	Percentage of projects providing specific services as a share of total climate change projects in the region				
	Africa	Arab States	Asia and the Pacific	Europe and the CIS	Latin America and the Caribbean
	%	%	%	%	%
Cooking	33	18	19	10	15
Lighting	16	11	33		52
Irrigation system or water pumping	19	7	4	5	8
General household services	6	18	19	15	6
Water heating	3	27	19	10	5
Battery charging	3		1		
Grain milling	3		6		3
Crop drying	2	6	2		5
Electric fencing	2				2
Water desalination				5	
Refrigeration/ice making		2	2		
Fuel for internal combustion engines				8	
Heating (home)				51	

Source: analysis of SGP climate change projects from 1992 to 2002
Note: Given that Table 5 contains select cases of end-uses, the total for each region does not add up to 100%.

2.4 Livelihood aspects benefiting from energy services supported by SGP

A range of livelihood sectors benefit from energy services provided by SGP climate change projects. These are examined below.

2.4.1 Health

Energy services provided through climate change initiatives can lead to significant health benefits. This is one important way in which SGP activities contribute directly to the achievement of three of the MDGs relating to health.

SGP projects generate health benefits in three major ways. First, a number of SGP projects provide better access to safe drinking water through water pumps powered by renewable energy, or even solar-powered water desalination. Second, other projects improve access to electricity in health clinics. Renewable energy sources can be particularly helpful in remote regions, enabling health clinics refrigerate medicines and vaccines, sterilize appliances, heat water and provide better care due to improved lighting. Finally, SGP projects help create healthy living and working conditions. For example, energy efficient housing and building techniques, particularly in colder environments, help to improve indoor temperature control. Efficient cookstoves help improve air quality in homes and institutions. **Case study 1** examines how fuel-efficient, smokeless stoves have brought considerable health benefits to villages in the Changa Manga region of Pakistan

Case study 1
Fuel-efficient smokeless stoves in Pakistan bring health and environmental benefits

Background: *The Fuel-efficient smokeless stoves* project was implemented in two phases in the Changa Manga region of Pakistan between 1995-1996 and between November 1999 and April 2002 by the Escorts Foundation. SGP provided grants of $7,500 (July 1995) and $32,698 (November 1999). The Changa Manga region, situated approximately 80 kilometers from Lahore, includes a set of 55 villages surviving on the edge of the largest planted forest reserve in Pakistan, the Changa Manga Forest Reserve. This is a protected area, but it is subject to pressure from local inhabitants dependent on firewood for cooking. The communities are extremely poor and have very low literacy rates. There is a high rate of tree cutting for firewood from the protected area, with some villagers selling firewood from the forest to generate income. Smoke and soot from traditional stoves coat women's kitchens, cooking utensils and hands. These women also suffer from a variety of illnesses and trauma related to smoke inhalation.

Project implementation: The project sought to spread the use of smokeless stoves among women in the area to reduce their dependence upon firewood and improve their health and general living conditions. The Escorts Foundation based the project on a stove construction and dissemination model successfully used by the Family Planning Association of Pakistan, which was in turn adapted from work on improved stoves in India. The Escorts Foundation did not subsidize the purchase of the stoves to promote use (as in India), believing that users must invest a minimal amount to promote commitment to using the stove. The project began with consultations with village leaders and then other stakeholders to set up training sessions on how to construct and use the stoves. At the end of each training session, two women volunteers from each village took home stove construction kits. They became responsible for motivating other women to use the stoves, and for evaluating and monitoring post-construction use of the stoves.

Benefits and impacts: The major global environmental benefit associated with this project is the reduction of greenhouse gas emissions from fuel wood burning. In 2000, the project estimated that the project avoided at least 10.84Gt of carbon dioxide emissions annually through the 5,476 stoves in use in 24 villages at that time.

Today, with 11,728 stoves constructed, the estimated GHG emissions avoided annually are almost double. These assumptions are based on an average usage rate of five-six kilograms of wood per day on traditional stoves, which the improved stoves halve. The region's stove adoption rate now stands at 70 per cent as of 1995. Locally, the forest reserve is less subject now to illegal woodcutting, benefiting the diverse flora and fauna located in the reserve. Indoor air pollution levels have been drastically reduced and kitchen hygiene has improved. Many families now buy 50 per cent less wood than before, resulting in saved income that can be used to meet other needs. The project has also provided employment opportunities for women and has lifted their social status in the village. The entire project is geared to strengthening the capacity of local women to build and disseminate the improved stoves, enabling them to take action to improve their own and their families' well-being. Thanks to the Escorts Foundation's high level of success in this area, it is now hosting training sessions for other NGOs willing to support similar projects elsewhere in Pakistan.

2.4.2 Agriculture

The SGP climate change portfolio reveals that the agricultural sector receives most benefits from energy services derived from SGP supported climate change projects. Specifically, the sector has benefited from the pumping of water for irrigation powered by solar panels, wind energy and micro-hydropower. Agro-processing activities have been enhanced through solar drying, refrigeration and the powering of machinery to process peanuts, mill grain, hull rice and de-husk coffee. Biogas activities recycle the waste products (slurry) generated by biogas digesters as fertilizer, and waste management projects have generated manure or briquettes for energy. SGP has also supported renewable energy projects to dry rice in Thailand (see **case study 2**) and to dry medicinal plants in Egypt and the Occupied Palestinian Territories (see **case study 3**). Community micro-hydropower projects in some SGP countries make use of canals for irrigation by day and electricity generation by night for households. See also **case study 4** about the *Clean rivers project* in Kazakhstan, which has supported the use of biogas technology to help provide low-cost energy from agricultural waste material and to reduce the contamination of a local river due to waste dumping.

Case study 2
Energy efficient stoves and kilns promote sustainable agriculture in Thailand

Background: The Institute for Sustainable Agriculture Development (ISAD) in Sunsai district of northern Thailand implemented the *Energy efficiency and the promotion of sustainable agriculture* project with an SGP grant of $7,234 between 2000-2001. Here, cooking is done using firewood and charcoal is produced from wood extracted from local forests. In the Tambol Mae Tha area, encompassing seven villages, firewood is becoming increasingly scarce. Women must travel further to get it or pay more for it. Forest destruction is a problem nationally; 75 per cent of Thailand's original forests are gone.

Project implementation: Together with local communities, ISAD designed the project to improve cooking and charcoal production processes to reduce impacts on the forest while generating local livelihood benefits, especially for women. 50 farmers set about building the more efficient terracotta stoves, which use less wood and cook food faster, generating a high demand from local women. Men continue to build the stoves, while women sell them by demonstrating their use in the market place, cooking two meals side by side on an open fire using old and new style stoves. The new stove demonstrates the more efficient energy use. The women also use the stoves to make and sell snack foods, such as rice puffs. In addition, the project has introduced fast-growing trees that the community can harvest in a sustainable manner and established a new method of making charcoal using airtight steel drums as kilns. This process produces "wood vinegar" as a by-product, which is a fertilizer. Charcoal producers can sell the vinegar by the bottle for use in gardens and composting, so reducing use of artificial fertilizers.

Benefits and impacts: Net greenhouse gas emissions from burning wood are reduced through the use of efficient clay stoves and the planting and harvesting of trees in a sustainable manner for charcoal production. Approximately 400 stoves are being produced each month. Forests in the region are benefiting from less wood collection, which is helping to protect local ecosystems and local water supplies. In addition, "wood vinegar" is now available as an organic fertilizer. To the extent that it replaces the use of non-organic fertilizers, it offers positive local environmental benefits. The sale of stoves, biofertilizer and snacks help to supplement local incomes.

Case study 3
Utilizing solar energy for drying agricultural crops and medicinal herbs in the Occupied Palestinian Territories

Background: *The Utilizing solar energy for drying agricultural crops and medicinal herbs* project was implemented by the Union of Agricultural Work Committee (UAWC) in Gaza with an SGP grant of $32,500 between August 2001 and June 2002. The Occupied Palestinian Territories is one of the most densely populated regions in the Middle East. Many people (approximately 15 per cent) of the West Bank and Gaza do not have access to electricity. Grid electricity is costly for those who are connected to it. Solar and other forms of renewable energy therefore offer independent and affordable energy sources. Women have traditionally dried native herbs in the sun for sale, but this can be time-consuming and takes away their color and freshness. Employment or other income-generating activities are very scarce in Deir al Balah and Abassan Al Jadidah, the communities where this project takes place, reflecting the difficult economic situation throughout Gaza. Solar dryers offer improved product quality in a shorter time period. The project works almost exclusively with women.

Project implementation: This project supported 17 small women's cooperatives that use solar dryers to process native fruits, herbs and other produce for sale in local markets. The project has conducted workshops and training sessions to show how the solar dryer works and how to package and market produce. UAWC initiated the project by canvassing women in Deir Al-Balah and Abassan Al Jadidah who were interested in crop drying and could maintain a solar dryer in their homes. The solar dryer is installed in the backyard of one woman's house, and a cooperative consisting of three to five women is formed. These women pool their crops and herbs, growing some themselves and buying others at the market. They dry them in the solar dryer, package and sell them, and share the income they earn. UAWC has published brochures about the solar dryers and their benefits, and distributed them through workshops for neighboring communities in order to disseminate the technology.

Benefits and impacts: Previously, women would dry some produce in the sun, but this took a long time, so they began to use gas-powered ovens to accelerate the process. Solar dryers have therefore helped replace this use of fossil fuels. In terms of livelihoods, the project has helped women generate additional income. The husbands of many women participating in the cooperatives are unemployed, so the income generated from this project is critical for the families. Currently, 65 women are working in 17 cooperatives. UAWC has conducted workshops, totaling 70 training hours. Its main outcome is the provision of income-generating opportunities for women independent of institutional support. Local women have learned important technical and business skills and now run the cooperatives on their own. Other donors are keen to expand these efforts. At the time of writing this report, the German Fund for Palestinian NGOs is currently funding the same grantee, UAWC, to build 15 solar dryers and to train women to use them and market their produce. The Canadian International Development Agency (CIDA) is in discussions with UAWC regarding the SGP project, and has asked UAWC to submit a proposal to them to expand the project.

Case study 4
Forging partnerships for the Clean rivers project in Kazakhstan

Background: *The Clean rivers* project was implemented by Karaganda Ecological Museum during 2000-2002 with an SGP grant of $47,000. The project sought to promote the use of biogas technology to help provide low-cost energy from agricultural waste material and to reduce the contamination of the river due to waste dumping.

Project implementation: Biogas facilities were designed, constructed and installed by a number of local enterprises, farms and institutions in the Karaganda community. Partners in the project included:

- **Farmers:** As the primary users of biogas energy and fertilizer, their cooperation and support was essential. Farmers associations contributed agricultural waste products used to produce biogas, so reducing the dump ing of the waste in the local river systems. In return, farmers receive gas for cooking and lighting and to produce environmentally friendly fertilizer for better crop productivity.
- **Businesses:** Local businesses manufacture the biogas units. Since the market for small-scale digesters is not large (few farming families can afford to buy them), companies produce larger scale ones for henneries or other livestock businesses. One company has been in negotiations since July 2002 to supply the components of large digesters. Inputs to construct the digesters for this project, such as concrete, polyethylene film and pipes, come from local companies.
- **University students:** Students have been responsible for designing biogas units that suit local conditions.
- **Local government:** Government officials are supportive of the project. They are now working to ensure that the local legal framework supports biogas production and use and to share successful results with policymakers in other districts and at the national level for replication.
- **Media:** The project reached out extensively to the media. Project activities have been covered in radio, TV and print news. This has improved awareness about biogas use and its connection to the river, generated support for favorable legislation for biogas use and helped to increase the size of the market for biogas units.
- **Volunteers:** Local volunteers cleaned the river beaches where harmful materials were previously dumped, and systems for river maintenance were established.

Benefits and impacts: Biogas use now replaces coal for heating and natural gas for cooking and lighting in the participating farms, so reducing carbon dioxide emissions. In addition, less manure decomposes in the open air, which reduces methane emissions and other greenhouse gases. A total of five digesters totaling 306 cubic meters in capacity have been built, and three additional digesters with 156 cubic meters of capacity are planned. Based on this project's experience, an eight cubic meter digester using pig manure can provide enough biogas to meet the cooking needs of a family of five, who previously used natural gas. The reduced amount of agricultural waste dumped near the Nura river means that it suffers less from contamination by ammonia-nitrogen compounds. Farmers can use the gas produced by the biogas facilities for free, saving them money on energy use. Previously, an average family would spend $100 per year on natural gas for cooking, and $100-200 on coal for heating. These costs are now avoided; however, an eight cubic meter digester costs $960. This initial investment pays off over a period of years, but credit mechanisms are necessary to support upfront purchases. Farmers use the fertilizer produced as a by-product, which helps improve their crop yields by approximately 20 per cent. Four additional workers have been hired to construct more biogas facilities, and others have been hired to operate them. A number of people have gained seasonal jobs at private beaches as a result of less contaminated water.

2.4.3 Water

Solar, wind and micro-hydropowered pumps in several communities working with SGP provide piped clean water for household use (both human and livestock) and irrigation. See **case study 5** for a description of an electrification and micro-irrigation project in Cachimayo, Bolivia and **case study 6** for details of a project promoting the use of solar photovoltaics (PV) to pump water to rural areas of Albania. **Case study 7** examines water desalination activities in Mauritius.

Case study 5
Electrification and micro-irrigation in Cachimayo, Bolivia

Background: *The Electrification and micro-irrigation in Cachimayo* project was implemented in the village of Cachimayo in the department of Tarija in the inter-Andean valleys between 1997-1998 with an SGP grant of $19,797. Here, up high, there are numerous poor and remote villages. Most do not have access to electricity, and depend upon candles, batteries and diesel for their energy. Due to their isolation, it is unlikely the grid will reach these villages anytime in the near future.

Project implementation: The project sought to bring electricity and irrigation to the community of Cachimayo through the large-scale construction of a canal which channels water through the village. The channel consists of 1,134 meters of piping and an electricity distribution network involving 3,300 meters of community-installed high-voltage cable and 2,800 meters of low-voltage cable. By day it is used for irrigation and by night it is used for electricity generation. A private company, Hidrosol, provided the technical design for the plant and training for community members engaged in the project. An administration committee has been established to set rates and collect payments for electricity and irrigation use, while five community members have been trained to maintain and operate the plants. Their salaries are paid by the electricity tariffs, which stand at 3 bolivianos (approximately $0.50) per light bulb per month. The project is based on common ownership of a power source for communal use.

Benefits and impacts: The community previously used batteries and/or candles for lighting, but can now rely on light bulbs powered by hydropower. This reduces carbon dioxide emissions. Through the project, 37 families receive 186W each, enough to power three light bulbs and one electrical appliance. The construction of the micro-hydro plant had the added benefit of bringing water within reach for the irrigation of family farming plots. This improves agricultural yields, thereby improving access to food and/or income from the sale of agricultural products.

Case study 6
Using solar PVs to pump water to rural areas of Albania

Background: *The Photovoltaic use for water supply to rural areas in Albania* project was implemented by the Energy Efficiency Center (EEC) with an SGP grant of $29,960. Albania is undergoing a serious energy crisis due to insufficient investment in power generation and distribution, combined with a major increase in energy demand. Prices have been rising, putting pressure on those who have low incomes. At the same time, usage limits are also becoming stricter. Very little, if any, solar energy is being harnessed in Albania to meet this demand. The project explores this potential. The project started in June 2002 and ended in June 2003.

Project implementation: This project tested the viability of using solar energy to pump water in two villages in Albania. In one village, PVs were used to pump water for household use, and in another, they were used for

agricultural irrigation. EEC started the project by selecting the two villages to test the PV panels and, after researching the market, they selected a supplier of PV equipment. The villages had some existing water supply infrastructure that had been put in place by the Catholic Fund for Overseas Development (CAFOD). The project made as much use of this infrastructure as possible to pump water. For example, instead of installing battery systems for storing electricity, it turned out to be more cost-effective to construct water reservoirs in order to deal with peak hours of water consumption. After receiving training from the supplier, members of EEC installed the water supply systems and then trained villagers to maintain and operate them. In the village where PVs are used for irrigation, the panels were mounted on a farmer's roof and he became responsible for maintaining them. The other village decided to pay someone to take care of maintenance. Installation was followed by an awareness campaign and a survey to assess the impact on villagers' lives.

Benefits and impacts: The villages now have access to drinking water for household use and for irrigation, which increases the farmers' ability to grow crops and generate income.

Case study 7
Solar-powered water desalination in Mauritius

Background: *The Solar water desalination in coastal villages* project implemented by the Rodrigues Council of Social Services was supported by SGP with a contribution of $30,279 between 1997-2000. The island of Rodrigues is located 320 nautical miles from Mauritius. Located along the southern coast of this island, the 21 families residing in the village of Cité Patate are refugees of the Celine II cyclone. This coastal community is surrounded by seawater, and makes its living mainly from fishing. Drinking water is another story. They are normally hard-pressed to find drinking water. It does not rain often there, but when it does the community catches all the rainwater it can in large tanks. When these tanks are empty, women must generally walk three to five hours per day to a natural spring to find and carry home water for their families. However, even this water from the spring is not always suitable for drinking and may carry disease.

Project implementation: This project developed locally constructed solar water desalination units and installed them in the remote community of Cité Patate, providing the 21 households with nearby access to drinking water. The project demonstrates the use of solar energy to desalinate water, an approach that may be usable in other areas of Mauritius. The idea for this project emerged from a stakeholder workshop held by SGP in Mauritius where specialists made a presentation about renewable energy at the University of Mauritius (UoM). The president of the Rodrigues Council of Social Services participated in the workshop and put forward the proposal for this project focusing on the possibility of using solar energy to desalinate seawater. The technical design and the prototype for the desalination stills were prepared by a specialist at UoM, who then worked with a local company that manufactures boats using fiberglass to construct 20 replicates of the prototype still that had been shipped to Rodrigues. The stills were then installed in the backyards of the 21 families of Cité Patate. These families contributed to the project by building a well for easy access to seawater, which is then placed in the still to desalinate. For every ten liters of seawater, three to seven liters of drinking water are produced in a day. This water must still be treated with minerals before drinking.

Benefits and impacts: The primary beneficiaries of this project are the 21 families of the Cité Patate village on the island of Rodrigues. The project also demonstrates to the local authorities in Rodrigues that solar water desalination can be practically implemented by use of solar energy. By enabling the families to convert seawater into drinking water, this project increases the community's capacity to cope with long periods without rain. This project demonstrates an option for small island states working to provide access to drinking water.

2.4.4 Electricity and linking with the national grid

In addition to integrating energy into other sectors, SGP is supporting the integration of renewable energy activities into national grid systems. **Case study 8** examines how the Kali Maron micro-hydropower scheme became linked to the national grid in Indonesia.

Case study 8
Linking with the national grid in Indonesia

Background: Funded by SGP in August 2000 with a grant of $27,388, the *Seloliman-Kali Maron project to upgrade the capacity of a microhydro facility to enhance the development of the local community* was implemented by the Konsorsium Seloliman in East Java, Indonesia. Project activities enhanced the capacity of an existing micro-hydro plant, which had been installed with the assistance of the German development agency GTZ in collaboration with a local center for environmental learning, known as PPLH Seloliman. Now the plant has a 23KW capacity, of which PPLH Seloliman and the community use 10KW. In addition to lighting homes and the environmental center, power is used to run a cotton blower and a paper crusher. The cotton is then used by a local Muslim boarding school to make mattresses, which can be sold for $25-$30 each. However, the community, which owns and operates the power plant through the Konsorsium Seloliman, still has excess power.

Grid connection: In 2002, new regulations were put in place that make it possible for small power producers to sell to the grid, and this community may be the first to test this possibility. PPLH Seloliman is providing technical support to the Konsorsium Seloliman in the negotiations and is training community leaders to manage the process themselves.

Future benefits and challenges: The cooperative estimates that the agreement with the national power company will produce about $400-$450 per month of income. This revenue will be used to establish a capital fund for village development projects. There has been some discussion, however, about the elimination of electricity tariffs in the community, since these profits would also be enough to cover the cost of system maintenance. This and other challenges remain to be resolved as the community moves forward with this new venture.

In Morocco, SGP has supported the capacity development of a group of young entrepreneurs associated with the national electrification programme. See **case study 9** for more details.

Case study 9
Building the capacities of energy micro-enterprises in Morocco

Background: Since 1996, Morocco has pursued an aggressive rural electrification programme through the Office of National Electrification. Morocco's approach involves two components. In some cases, the government helps support the extension of the grid. In other cases, the government contracts private retailers to install solar home systems, providing a one time payment of $300 per home. This second approach, particularly pursued in the northern part of Morocco, depends upon the existence of local micro-enterprises in un-electrified regions to install solar home systems and guarantee them for a seven to ten year period in return for monthly payments from customers. The *Building capacity for leaders of energy micro-enterprises* project was implemented by the Group for Study and Research on Renewable Energies between 2000-2001 for one year with an SGP grant of $41,241.

Project implementation: This project sought to build the capacity of 30 young entrepreneurs who run rural energy micro-enterprises that install solar home systems to inform and educate them about the full range of renewable

energy sources (including solar, biogas and the gasification of biomass) and how they relate to the agriculture, water use and food preparation sectors. A consulting service has been put in place to advise enterprises about handling energy issues.

Benefits and impacts: While this project has not directly provided energy services, it delivers substantial support to micro-enterprises that do. The potential impact of the project is important given the scale of the national electrification process; in 1999, 1,650 villages were electrified, many by micro-enterprises. Micro-enterprises provide gainful employment to local populations. In the first phase of the project (prior to the implementation of this grant), 17 micro-enterprises provided employment to a total of 41 people.

2.4.5 Education

Many SGP-supported climate change initiatives lead to improved access to education. Some projects provide power to schools, which improves the students' learning environment through better lighting or access to computers. Improved lighting at home is also important, since children have an easier time studying at night. Reduced dependence on firewood, which children are often responsible for collecting, can free up their time for educational activities. Finally, other projects have demonstrated ways in which environmental education can be incorporated into the school curriculum. For example, in the Polocón community in the Philippines students are required to participate in watershed restoration activities in order to graduate. This emerged after the community built a micro-hydro power plant, which depends upon the watershed to maintain the water supply. See **case study 10** for more details.

Case study 10
Hydropower and watershed protection in the mountains of Mindanao, Philippines

Background: Polocón is a small farming community of approximately 100 households located in the southernmost part of the Philippines. Polocón, and other communities like it, was established in the 1960s and 1970s when logging companies opened roads and began deforesting this tropical region. Today, the original forest is nearly gone, and instead the area is covered with secondary forest and farmland. Although it is technically part of the country's third largest metropolis, Davao City, the city's electric grid ends 20 kilometers away and there is little hope for its extension in coming years. Only a few families in Polocón have access to electricity via a shared diesel generator. Others use car batteries, which they have to transport by "jeepney", the only available public transportation, to the nearest battery charging post. The closest telephone is also 20 kilometers away. The circumstances in surrounding settlements are similar; about half of the rural communities on the mountainous island of Mindanao lack electricity. In the Philippines overall, about 1.5 million people do not have access to electricity. The *Hydropower and watershed protection* project in Polocón was implemented by the NGO Yamog Renewable Energy Development Group Inc. The SGP provided a grant of $44,914. The project took two years starting in September 1998 and ending in September 2000.

Project implementation: The project sought to promote the implementation of a community-managed micro-hydro scheme. It demonstrates the significant environmental and livelihood benefits associated with the establishment of community-based renewable energy projects. The community was integrally involved in the design, building, operation and maintenance of the 15KW scheme in Polocón. Restoring and protecting a local watershed is a key element of this project, since without the 70-hectare watershed, the river's flow would decrease and the micro-hydro plant would not work.

Benefits and impacts: 110 households, as well as most public places, are benefiting from electricity. Diesel generators and kerosene for indoor lighting are no longer used. People in neighboring villages can now come to Polocón

to recharge their batteries and grind their corn using renewable instead of fossil fuel power. They pay for the service, generating income for villagers. Local pastures and farmland have been reforested with native species and fruit trees, helping restore the local ecosystem following decades of government reforestation with exotic species. Project leaders are coordinating with the Department of the Environment and Natural Resources to reforest the areas more distant from Polocón. The community has re-planted 25 of the 70 hectares in the watershed region. The community has institutionalized watershed protection, requiring each elementary school student to plant and care for ten trees in order to graduate. Conserving the watershed helps store carbon in the newly growing forest there and sustains the flow of water in the local river so maintaining a good water supply for Polocón and the communities downstream. The community has built their capacity to manage the micro-hydro plant, which has been integrated into the overall development of the community by channeling funds from milling and battery-charging services into the local school and other community needs.

The community of El Limón in the Dominican Republic has managed to connect the school to the Internet. Children and the community can get ready access to and make use of computer training facilities. The community has noticed that more children are attending school for longer and are achieving higher grades as a result of better studying and learning conditions brought about by the community micro-hydropower project. This project is described in **case study 11**. Refer also **case study 21** on communal solar electricity in Côte d'Ivoire for a similar experience.

Case study 11
El Limón micro-hydropower project in the Dominican Republic: Generating cross-sectoral benefits

Background: Approximately two million people—between 300,000 and 400,000 households—in the rural areas of the Dominican Republic have no access to electricity. The extension of the electric grid is not expected to reach these communities for many years, since they are so dispersed and demand so little power that even mini-grids are not an economic solution. Without electricity, these communities are extremely isolated with little opportunity for economic improvement. Insufficient rainfall means that the town's main sources of income are raising goats and making charcoal. As a result, the nearby forest was being rapidly depleted as villagers harvest wood. Until a local NGO lent money and technical assistance in the early 1990s to the community for the construction of an irrigation system to pipe water into the village from a stream six kilometers away, the community depended on poor quality kerosene for lighting, which caused severe indoor air quality problems and forced the use of expensive batteries for other electricity needs. A local CBO, representing the community of El Limón situated in the mountains west of Santo Domingo, received an SGP grant totaling $27,500 in support of the *Electrification of the El Limón Community* project. The project started in September 1997 and was completed in 1998.

Project implementation: This project established a micro-hydropower scheme to provide electricity for lighting homes and the local school. The community spent a year building the plant; each person gave one day a week to help construct the plant. The turbine is located in a cement building in the forest above the town. Electricity is distributed via power lines suspended on 135 locally made cement poles. After passing through the turbine, water continues down to the community to be used for irrigation. An hydro-electric committee has been established to collect electricity tariffs for maintenance and future repairs. Later in the project, the Inter-American Foundation donated money for laptop computers and video equipment and helped to set up Internet access at the school that does not depend upon telephone lines, which are not available in El Limón. The system uses a digital radio, a repeater and a modem.

Benefits and impacts: The El Limón project illustrates how the introduction of micro-hydropower can translate into local as well as global environmental benefits. Households no longer use kerosene. Instead, they rely on

hydroelectric power, thereby reducing GHG emissions. Since the hydroelectric system was built, the people of El Limón have begun to protect the local forest. The forest provides a filtering system for the area's sparse rainfall, and without it hydroelectric power would not be possible. El Limón has also begun an educational campaign to inform other local communities about the importance of protecting the forest. The steps taken to protect the local watershed and forest are a direct result of the introduction of micro-hydropower in the area. In addition, the project shows how energy projects can be integrated into agricultural, education and conservation activities. Electricity produced by the water during the day is used at the school, where it powers computers and lighting. At night, the electricity is used for lighting homes.

Before El Limón got electric light, black kerosene smoke discolored interior walls and clothing, and caused a high incidence of colds and asthma in the community. Now the town has electricity and light, local children are generally healthier. But the greatest benefit is the lighting of the school and establishment of computer classes. The children used to have to study by candlelight at night, now they just switch on the light. My grandchildren are learning to use computers and navigate the Internet—Diana Mateo, a member of El Limón's Women's Association

2.4.6 Private sector

A number of SGP projects have designed activities that are helping small enterprises to be commercially successful. Most of these projects focus on renewable energy and energy efficiency activities, such as the manufacture of efficient kilns, efficient housing materials and improved stoves. Some individual community members are involved in solar businesses established with SGP support.

Four general categories of enterprises created through climate change or energy activities have been identified:

- Trading in renewable energy or energy efficiency equipment, including solar panels, manure composters, efficient kilns or improved stoves.
- Providing infrastructure services on a commercial basis for the maintenance, servicing and repair of existing equipment for solar home systems, micro-hydropower schemes, wind energy systems, biogas units and energy efficient systems.
- Offering energy services on a commercial basis. For example, brick making, battery charging, paper making, rice milling and hulling, grain milling, coffee hulling, bread making, cold storage and ice making.
- Providing energy audit services on a commercial basis.

In many cases, SGP climate change projects have been designed to create new opportunities for commerce and increase productivity. Energy services provide more time for communities to focus on economic activities to generate additional income. When rural communities living in remote mountain villages in Nepal were provided with solar panels, they knitted bags at night and marketed them for sale over the Internet with the assistance of an NGO. See **case study 12**.

Case study 12
Financing solar communities: The Solar Village Electrification Demonstration Project (SOVED) and the Home Employment and Lighting Package (HELPTM) in Nepal

Background: The Nepalese government established the Alternative Energy Promotion Centre (AEPC) in 1996 to provide subsidies covering up to 50 per cent of the cost of a solar home system. Between January 2001 and November 2002, AEPC committed approximately $1.8 million for such subsidies. 16 private companies now supply solar home systems in Nepal. These suppliers import panels and batteries and manufacture control boxes and other solar home system components domestically. However, even with the subsidy—for which

demand far exceeds supply—the poorest villagers do not have the cash to pay off the remaining 50 per cent of the panel's cost, and do not have collateral to put down for a loan. Only the most affluent villagers can access loans, and therefore they obtain the subsidies as well. The poorest have little option but to continue buying and hauling kerosene, which must be imported using precious foreign exchange. Kerosene contributes to global climate change, and creates serious local air quality problems. Households also purchase dry cell batteries to power radios and flashlights, which are generally not disposed of properly. The purchase of kerosene and batteries accounts for about 20 per cent of a village household's income. A local NGO, the Himalayan Light Foundation (HLF), received $50,000 in 1999 from SGP for the implementation of the *Solar Village Electrification Demonstration* (*SOVED*) project, which was part of their *Home Employment and Lighting Package* (*HELP*) in Bongadovan in the district of Baglung. The project took one year to complete from 1999 to 2000.

Project implementation: This project primarily removes financial barriers to the adoption of renewable energy. It seeks to demonstrate a flexible credit scheme that enables the poorest members of Nepalese villages, who have little cash and no collateral, to obtain solar PV panels. At the same time, the project creates a source of income for the long-term by building skills and capacity to produce handicraft goods for sale. Women commit to knitting one traditionally designed bag per month to pay off the loan for the solar panel. Participants are also granted access to the AEPC subsidy. After two years, the loan is paid off and income from the sale of bags marketed over the Internet is placed in a revolving fund under the control of the villagers, called the Revolving Electrification and Income Enterprise Fund (RELIEF™). Once the fund is large enough, villagers without solar panels can borrow from the fund to purchase solar panels and repay by knitting the bags.

The role of the private sector: The success of marketing products over the Internet has enabled HLF to establish an "e-shop" where increasing numbers of new products can be sold to benefit poor communities. HLF has added paper products produced by another village in return for solar panels to scale up this project. HLF also believes "energy branding" is important. If purchasers know that a product is contributing to energy access in Nepal, the consumer may be willing to pay more. This is one of the reasons why HLF has trademarked the names of its programs: HELP™ , RELIEF™ and Solar Sisters™. HLF hopes these names will come to be associated with clean energy and improved livelihoods, and that eventually a private company may take over the enterprise.

Other projects have focused on helping existing small-scale enterprises become more efficient in their operations and so more profitable. For example:

- In the Dominican Republic, energy inefficient refrigerators are now being modified by small enterprises to increase their efficiency and reduce their impact on the environment while creating new jobs in the sector.
- In Zimbabwe, 12 small, medium and informal sector enterprises were selected as part of an SGP project to benefit from the adoption of methods of production that use energy efficiently, generate less emissions, effluents and wastes than traditional practices and raises incomes of the micro enterprises. See **case study 13** for details.
- In Thailand, Viet Nam, Bhutan, Pakistan and other SGP supported countries, SGP projects have led to the start-up of micro-enterprises selling improved stoves and bricks made from efficient kilns. In other countries such as Sri Lanka, communities have started commercial production of breads baked from improved efficient baking ovens. See **case study 14**.
- In Kenya, the Tungu Kabiri community micro-hydro scheme has generated power used by a group of micro-enterprises who pay rent and power tariffs to the community who own and operate the scheme. See **case study 16**.

Case study 13
Energy efficiency measures in 12 small, medium and informal sector enterprises in Zimbabwe: Profitable businesses, healthy workers

Background: In Zimbabwe, statistics from the Ministry of Industry and Trade show that small and medium scale enterprises (SME) and informal sector enterprises (ISE) employ about 1.6 million people (1997) nationally. Of the 1.6 million, SMEs contribute approximately 500,000 jobs while ISEs contribute 1.1 million jobs. As the SME sector continues to grow, there is also a corresponding growth in the amount of energy, water and raw materials used for production of goods and provision of services. The negative environmental impacts associated with their activities are increasing. Although negative environmental impacts from a single enterprise are comparatively small, the aggregate impacts from all these enterprises are massive. The NGO HERITAGE Environmental Services received an SGP grant of $48,720 to implement the *Energy efficiency and conservation pilot* project in Zimbabwe. The project was implemented during 2001-2003.

Project implementation: HERITAGE, in collaboration with other stakeholders, trained 12 SMEs and ISEs to utilize energy in an efficient and environmentally friendly manner. Expected outputs included:

- Reduction in energy consumption, both in energy units and costs per unit of product, contributing towards the reduction of greenhouse gas emissions (60 per cent of local electricity supply is from coal fired power generating plants).
- A functional energy management programme to guide activities.
- Increased awareness of the negative environmental impacts of inefficient energy usage.
- Improved competitiveness of products due to reduced production costs.

Benefits and impacts: In quantitative terms, the project anticipated a reduction of energy usage per unit of service ranging from 10 to 30 per cent of current consumption patterns and at least one person trained in energy efficiency management per enterprise. On-the-job training focused on energy recording and processing techniques and equipment operation. All 12 enterprises received training, and the average in-class training session attendance was 10 representatives per enterprise. They learned that energy consumption can be controlled, benefiting production processes and profits and reducing occupational pollution levels.

Case Study 14
Patents and the introduction of rice paddy husk as an alternative to firewood for the operation of bakeries in Sri Lanka

Background: More than 90 per cent of Sri Lanka's bakeries use firewood to fuel their ovens, accounting for nine per cent of total biomass fuel used in the country since 1995. A medium-sized bakery uses about three cubic feet of firewood per day; a single medium-sized tree provides about four cubic feet. Some firewood is taken illegally from protected forests. Only 23 per cent of Sri Lanka's forests remain. In addition, rice mills regularly discard paddy husks by roadsides and streams. Due to its high silica content, paddy husk takes a long time to decompose. Villagers eventually burn the "mountains" of paddy husk, which release carbon dioxide as well as lightweight ash. Paddy husks also attract wild elephants, which can cause property damage. The Integrated Development Association (IDEA) received an SGP grant of $7,497 to implement the project *Introduction of paddy husk as an alternative to firewood for the operation of bakeries* in Polonnaruwa district of Sri Lanka. The project started in September 2000 and was completed in June 2001.

Project implementation: The project tested the use of a converted bakery oven that burns rice paddy husk instead of fuel wood, thereby reducing impacts on forests and alleviating the problem of paddy husk accumulation. Since the converted oven also costs less to operate, it was expected to increase income for bakers. The National Engineering Research and Development Centre of the Ministry of Science and Technology had conducted a pilot study on the possibility of converting bakery ovens to use paddy husk as fuel, but encountered problems when trying to maintain a minimum temperature due to the lightweight nature of paddy husk. The converted oven was developed by a local baker and tested over five years before being patented. IDEA learned about the baker's experiment and received permission to disseminate the invention. Prior to implementation, IDEA conducted a baseline study in the Polonnaruwa district, determining the number and size of bakeries and rice mills, bakers' income levels, firewood use and paddy husk discharge rates. A workshop was organized to advertise the new oven and five bakeries were selected as test sites for the oven. The oven uses a small amount of electricity to operate a huller that breaks up the paddy husk, and a blower that sends the husk into the combustion chamber. When electricity is not working, a hand-tractor can be used to power the huller and blower manually.

Benefits and impacts: Using the improved oven, the community bakery became more efficient enabling the owners to produce cheaper products to the benefit of the community as a whole. The patent holder worked with the community through a local research institute to train people how to use the technology. Both the patent owner and the community benefited from its widespread use. Previously, bakeries were spending about $4 per day to purchase three cubic feet of firewood. The new oven costs about $2.50 per month in electricity costs to operate, and paddy husk is currently available for free from rice mills. Although transportation costs must be paid, these amount to about $0.20 per day. However, an upfront investment of about $570 is necessary to purchase the oven. During the pilot project, the cost of ovens was split equally between the bakery owner and IDEA, but since then 15 more ovens have been built with bakeries covering even more of the cost. A few difficulties arose during the pilot project, but all were successfully addressed. For example, one bakery received complaints from a neighbor about ash emitted from the oven's chimney landing on his property. Raising the height of the chimney to 18 feet, he ensured that the ash settled back into the fire chamber. The ash is then expelled from the chamber into a collection area. A productive use has been found for the ash—"black ash" can be used as a fertilizer in paddy farming, and the "white ash" in banana and other vegetable cultivation. The higher chimneys also ensure that the smoke rises high enough into the air to avoid pollution and respiratory problems.

These examples demonstrate that the involvement of local private operators in capacity development and project implementation can stimulate community participation by ensuring sustained support for an activity.

2.4.7 Housing

Climate change activities are occasionally linked with housing sector initiatives. For example, a community working with the SGP in partnership with the Agha Khan Foundation in Pakistan has developed and introduced energy efficient building materials for use by households living in remote mountainous regions. Fuel-efficient improved stoves have led to the improvement of living conditions in the households. The initiative has also brought about the development of a new line of goods and services, which the community has commercialized. Climate change mitigation activities are also playing a critical role in improving energy efficiency in heating activities in the housing sector in Lithuania. See **case study 15**.

Case Study 15
Promoting energy efficiency in residential multi-apartment buildings in Lithuania

Background: Approximately 800,000 of the 1.3 million households in Lithuania reside in just 30,000 multi-apartment residential buildings. These buildings, most of which were built during the Soviet period between the 1960s to the 1990s, are in poor condition and are energy-inefficient. Energy costs have also been rising, placing a significant burden on households. In fact, in 1996 it was estimated that more than 70 per cent of Lithuanian households had difficulty paying their energy bills. In 1995, a law was passed in Lithuania to allow the establishment of Homeowner Associations (HOA), which could make decisions about infrastructure investments by majority vote. In 1998, approximately 15 per cent or 4,500 apartment buildings were managed by HOAs, and by 2002 this figure had risen to an estimated 6,000 apartment buildings or 20 per cent of the building stock. The Housing Advisory Agency (HAA) of Lithuania was awarded an SGP grant of $12,547 to implement the *Promotion of energy efficiency in residential multi-apartment buildings* project. The project was implemented during 2001-2002.

Project implementation: This project sought to raise awareness and capacity among apartment owners, municipalities, homeowner associations, and housing maintenance companies about techniques for improving heating efficiency and energy use in apartments. The project encouraged and enabled them to implement energy efficiency measures on a voluntary basis as a result of improved information and economic incentives. HAA focused its activities upon the six largest cities in Lithuania. In each city, it organized seminars and training sessions for apartment owners and homeowner associations, municipalities, and housing maintenance companies on energy management techniques. A total of 627 people attended these sessions and received training materials. During the project, 410 people received free individual consultations, and since the project ended, an additional 300 have also been advised.

Benefits and impacts: Evidence suggests that apartments that have benefited from energy efficiency improvements have an increased market value. Educational programmes and energy management software (written in Excel) outline ways to measure heat energy use and suggest ways to improve it. Heat lost through transmission, thin walls, roof and floor insulation, ventilation shafts, windows and inefficient water heating can be measured through this software. According to preliminary calculations, improved energy management techniques that do not require significant investment can reduce heat energy use by 10 per cent, which translates into a fuel savings of 15 per cent due to transmission and distribution losses. HAA has received many more requests for consultations than had been anticipated. This project improves the capacity of apartment owners, municipalities, homeowner associations, and housing maintenance companies to implement energy management techniques. The project has conducted media outreach, including with local newspapers, and was featured during UN Week (October 17-24, 2002), when it received wide national media coverage. The project removed institutional barriers, encouraging the establishment of an increased number of homeowner associations to promote energy efficiency technologies and techniques.

2.5 Removing barriers to climate change abatement

SGP projects operate in a wide range of political, economic, social, institutional and cultural contexts. As a result, SGP activities must address a diverse set of barriers to the adoption of renewable energy, the use of efficient energy technologies, and the development of environmentally sustainable transport options.

Barriers reflect the socio-economic and political aspects of countries that hinder the adoption and development of climate change projects at the community level or lower the capacity of a community to access goods or services related to climate change mitigation activities. Removal of barriers in the community context is

therefore a continuous development process meant to promote climate change abatement while ensuring sustainable development.

While the removal of barriers to energy efficiency and renewable energy forms the bulk of SGP's work on climate change, significant progress has also been made in a number of countries in promoting of environmentally sustainable transport.

Barriers identified during the review of the SGP climate change portfolio include:

- Weak technical capacity.
- Non-conformation of climate-friendly technologies and techniques to cultural or traditional practices.
- Lack of access to patented technologies and techniques.
- Inadequate policies and legislation.
- Dysfunctional institutions.
- Poor access to information and lack of knowledge.
- Lack of opportunities and exposure to new ideas and equipment
- Lack of financial resources

2.5.1 Weak technical capacity

Most projects, especially those employing renewable energy technologies, tend to focus on the removal of technical barriers. Technical barriers relate to the way that technologies function. Lack of or inadequate technical knowledge hinders adoption.

Technical barriers can be overcome by building the capacity of different sectors. Specifically, projects can strengthen the installation, repair, maintenance and operational capability of technicians, institutions and community members and/or the capacities of educational institutions to train people to carry out associated jobs. They are most commonly observed in renewable energy projects, such as community micro-hydropower schemes, wind energy, biogas, gasification and solar drying. They are also observed in some energy efficiency activities, especially where communities operate improved kilns.

Box 2. Wind energy supplies water in Egypt

To improve the technical capacity for the manufacture of wind pumps in Egypt, the wind energy for water pumping project (1995-1997) worked with local manufacturers to design and manufacture four different types of small-scale wind turbines for water pumping. The Egyptian Solar Energy Society worked with the Arab Manufacturing Authority—the largest manufacturing company in Egypt—to design and build the turbines. The four small-scale versions were built and installed in four villages between September 1996 and June 1998, pumping 700 to 2,400 liters of water per hour for agricultural use. After the project ended, several more turbines were manufactured at a lower per unit cost with greater operational capacity. One now pumps 3,000 liters of drinking water per hour, and another pumps 9,800 liters per hour for agricultural use.

2.5.2 Non-conformation of climate-friendly technologies and techniques to cultural or traditional practices.

Some SGP supported projects have addressed the removal of cultural barriers. Some cultural practices (which relate to the use of energy or energy resources) may hinder the adoption of energy efficient or renewable energy technologies. Practices vary from region to region depending on a community's beliefs and/or traditions. For example, while some communities will not use human waste to produce biogas, others will not use cow dung. In some cases, cultural practices dictate cooking methods and influence the type of stove or fireplace a household will acquire.

Certain beliefs and customs also hinder the adoption of sustainable transport technologies or practices. For instance, many communities in Africa view riding bicycles by women as inappropriate, given the design—most bicycles in the region have a straight top-bar. Recognizing these design problems and responding with adapted designs (such as a downward-curve connecting bar) addresses this barrier.

Box 3. Promoting the use of native fast-growing trees for cremation in Thailand

Barriers may relate to the use of fuels for religious ceremonies. Burning tyres is fast gaining popularity as the fuel of choice for religious cremations in Thailand. The fact that used tyres are easy and cheap to obtain and burn at very high temperatures makes them much more attractive than wood. Between 1998 and 1999, SGP Thailand supported a project titled "Promotion of Native Fast-Growing Trees for Cremation and Natural Resources and Environment Conservation". The project brought together a local religious institution, the Mahamakut Buddhist University in Chiang Mai and neighboring communities to promote the use of fast-growing trees instead of automobile tyres as fuel for cremations. Burning rubber pollutes the environment as a result of materials and chemicals used to harden tyres during production. An environmental education programme was developed by religious leaders to educate the community members about the use of the trees for religious practices. At the same time, "firewood banks" were born to encourage community savings. By the end of the project, the communities realized that they produced enough biomass resources to carry out cremations as well as undertake other productive activities in the housing, building and catering sectors. This SGP supported project stimulated the reversal of a practice that was damaging local environment and promoted the use of sustainable biomass resources.

2.5.3 Lack of access to patented technologies and techniques

Issues relating to patent ownership can hinder the adoption of energy technologies. Where potential users of new technologies are resource and cash-poor, they are unable to pay for and acquire cutting edge equipment. Refer again to case study 14, which examines how the owner of the patent rights to a fuel-efficient bread oven that uses paddy husk as fuel shared his invention with a community in Sri Lanka.

Box 4. Accessing patent rights for a solar thermal water heater in Kazakhstan

A partnership between a private company Erkin K. Ltd. and grantee CBO EcoEducation enabled the Kyzylorda community in Kazakhstan to access the patent rights to a solar thermal water heater technology for use in an orphanage. The private company allowed the CBO to manufacture the patented technology (in this case, solar collectors) and provided the full engineering specifications and technical documentation. The company forged this partnership with the community as a way to promote use of their technology while benefiting from the positive publicity. As a consequence, public awareness of the technology was raised while the community benefited from the services provided by the infant orphanage in a win-win outcome.

Box 5. Manufacturing a patented rotary composter for waste management in Mauritius

In Mauritius, an agreement between University of Mauritius (UoM), the grantee NGO National Federation of Young Farmers' Clubs and the 30 Belle Mare farming community was signed to allow the NGO to manufacture and use a patented design of a rotary composter for waste management. The grantee is replicating and commercially selling the composters on to the public and generating an income. SGP provided the funding. Demand for the composters has grown and the grantee is training their customers about composting techniques. The NGO has also negotiated a contract with a set of major commercial partners to sell compost in 1.5 kilogramme packets.

2.5.4 Inadequate policies

Policies are broad formal government statements that guide the development of a sector over a specific period of time. They define a formal set of principles for guiding government intervention and support for all sectors. Lack of or inadequate policies may become a hindrance or barrier to the development of a sector.

A significant number of SGP projects have addressed policy barriers. These barriers most often relate to energy, environmental or taxation policy. Policy changes have countrywide impacts and are important outcomes of SGP interventions. A number of projects have catalyzed the review of national and local policies towards decentralized energy service provision for communities living in dispersed and remote regions. See **case study 16**, which examines the experiences of Mbuiru village in implementing the first community-owned micro-hydropower scheme in Kenya, which led to improved decentralized power policy and legislation at the national level and broke down barriers to the adoption of renewable energy.

Case Study 16
Improving decentralized power policy and legislation in Kenya

Background: Hydropower is central to electricity provision in Kenya. Over 60 per cent of Kenya's electricity is provided through large hydropower schemes. In 1997, Kenya's Electric Power Act allowed independent power producers (IPPs) to supply electricity to the grid, but small-decentralized schemes (such as micro-hydropower) that could be used by off-grid communities were not adequately addressed in the Act. As a result, the country lacked policies promoting investment in decentralized power and official standards or incentives to encourage and enable individuals, companies or local communities to take advantage of renewable and environmentally benign sources of power. *The Tungu-Kabiri community micro-hydropower* project was implemented by the Intermediate Technology Development Group (ITDG) with two SGP grants of $38,500 for phase one (1998) and $25,000 for phase two (2000). The two phases took four years to complete from 1998 to 2002.

Project implementation: With support from SGP, the first community-owned micro-hydropower scheme was started in 1998 in Mbuiru Village in Chuka in the Meru region of Mt. Kenya. The project supported the Tungu-Kabiri community by setting up a pilot micro-hydro power scheme and training the beneficiaries on how to operate and run the scheme. ITDG worked closely with the Ministry of Energy from the outset of the project. The community manages the scheme and has provided the land, materials, labor and cash to purchase licenses and materials.

Benefits and impacts: The project stimulated a change in national policy and legislation relating to decentralized energy services through a single demonstration. Government support was won due to the fact that the project involved the Ministry of Energy as a partner from inception. With the benefit of direct experience in implementing a micro-hydropower scheme, the Ministry was inspired to review decentralized power policy in Kenya, leading to the improvement of energy policy relating to decentralized power production. Although the SGP grant has now been spent, ITDG continues monitoring the project and providing technical support. As a result of this project, the Ministry of Energy has set official standards for the micro-hydropower sector; capacity has been strengthened to undertake micro-hydro feasibility studies; capacity to manufacture and repair system components has been built; and other development partners have now supported two similar schemes in Kirinyaga District. Critically, new government legislation and policies have been introduced. In July 2002, a motion was passed in parliament recognizing the role of decentralized power schemes.

2.5.5 Inadequate legislation

Legislation is enacted by Acts of parliament which governs the production, distribution, use and access of power. Lack of legislation that sets regulations and official standards in support of decentralized power schemes is a critical barrier to the adoption of renewable energy in many developing countries. Legislative frameworks also regulate tariffs influencing the cost of power production, distribution, use and access. Governments sometimes use laws to manage revenues generated by the power sector and may consequently determine the efficiency of the power sector.

A number of SGP projects have inspired governments to enact, change or develop a legislative framework for a decentralized power sub-sector. Refer again to case study 16, which demonstrates that inadequate legislation is just as much a barrier to the adoption of renewable energy as lack of legislation. The case study notes that the Kenya Power Act enacted in 1997—despite the fact that it seeks to guide the operations of Independent Power Producers—does not address community-managed decentralized power schemes.

2.5.6 Dysfunctional institutions

UNDP defines local governance as a set of institutions, mechanisms and processes through which citizens and their groups can articulate their interests and needs, mediate their differences and exercise their rights and obligations at the local level. It requires partnership between local governmental institutions, civil society organizations and private sector for participatory, transparent, accountable and equitable service delivery and local development. It necessitates empowering local governments with authority and resources and building their capacity to function as participatory institutions that are responsive and accountable to the concerns and needs of all citizens. At the same time, it is concerned with strengthening of grass-roots democracy and empowering citizens, communities and their groups such as CBOs and NGOs to participate as equal partners in local governance and local development process.[22]

However, there are many cases in the SGP climate change portfolio where barriers to the adoption of renewable energy and energy efficiency technologies and practices are institutional in nature. Some relate to the way that local government institutions are structured or operate while others relate to the management and administrative structure of organizations and groups at the community level.

A common barrier affecting communities relates to access to natural resources such as land and water, tenure and licenses for use. Others relate to how communities organize themselves internally to access these same resources. Linking communities with the relevant authorities and facilitating dialogue between them is critical. See **case study 15** for analysis of the *Promotion of energy efficiency in apartment buildings* project in Lithuania, which has worked with HAA to bring together residents' associations, maintenance firms and government housing and energy departments in a new and impressive coalition to achieve financial savings and efficient energy use.

2.5.7 Lack of information and knowledge

Lack of information and knowledge about existing technology options has emerged as a major constraint to the adoption of renewable energy and energy efficiency technologies by communities in many countries. In particular, lack of information and knowledge about how to select an appropriate technology, use and maintain it remains a barrier to adoption among communities.

22. Source: http://www.undp.org/governance/local.htm.

SGP supported projects have sought to address this problem through various approaches, including one-on-one training; partnerships with specialized institutions such as universities and adult education centers, private sector companies, cooperatives and professional associations; public awareness campaigns; workshops and exhibitions about available technologies and useful techniques; and training, pilot and demonstration activities. These are now routine elements of many SGP projects.

2.5.8 Lack of opportunities and exposure to new ideas

Lack of opportunities and exposure to new ideas can hinder the adoption of climate-friendly practices. Habits can be hard to change without proof that doing something another way works better. Traditional knowledge and skills are generally passed from one generation to the other and experience shows that a traditional practice will scarcely change year to year if it is effective and still achieves its original purpose. Exposure, funds, training and capacity development are therefore required to convince communities to evolve their practices. It can be particularly difficult to persuade communities to utilize energy efficiency technologies, such as improved charcoal-making kilns, brick-making kilns and stoves. **Case study 17** explores how exposure to new technologies from China led to more efficient brick-making in communities in Viet Nam.

Case Study 17
Generating new opportunities and improving exposure to new technologies: Making bricks more efficiently in Viet Nam

Background: Brick-making is one of the largest industries in Viet Nam, where traditional kilns burning low quality, high sulfur coal produce poor quality bricks and cause severe negative environmental impacts. It is also traditionally carried out on a small scale by family-run businesses in rural areas. In 1998, there were over 300 brick-making enterprises, of which 200 were privately owned and predominantly small-scale accounting for approximately 70 per cent of total brick production. Brick production is one of the most environmentally damaging activities in the construction sector leads to intense local air pollution as well as greenhouse gas emissions. Improved and more efficient brick kilns have been developed in China in the Xuan Quan commune in the Hung Yen province where family-scale producers are very important. In Xuan Quan, local authorities recently issued strict limits upon the polluting brick kilns, generating the need for improved and more efficient brick-making technology. With SGP support, the Thermal Technology and Science Association (TTSA) of Viet Nam imported a new kiln type developed in China, and secured co-financing from a local university and a private sector kiln owner. Although the first prototype failed, a second more successful prototype was developed in early 2002. TTSA implemented the project titled *Developing a model of a vertical brick kiln with high efficiency* in the Hung Yen province of Viet Nam with an SGP grant of $32,145. The project took two years to complete from 2001 to 2003.

Project implementation: The project sought to develop and demonstrate a model of the vertical shaft brick kiln. In doing so, the project raised awareness among local brick-makers about the technology and educated local authorities about the effects of local pollution and of greenhouse gases. This project began its work by meeting with and organizing training workshops for local government officials as well as community members. The goal was to work closely with the community and with the government in developing a model for an efficient brick kiln that would be usable in this community as well as in other rural areas of Viet Nam. TTSA provided supervision and management for community members who were involved in designing the model, and then conducted an assessment of the model's efficiency. The final step of the project was to share the experience of developing this kiln with brick-makers in other communities via trainings and study tours.

Benefits and impacts: Results so far suggest significant cost savings, higher quality products, better working conditions, savings in coal consumption and reduced air pollution. While efforts to disseminate the new technology have barely begun, television and print media coverage has generated considerable interest. The grantee has received requests from 15 other provinces to build these kilns, while the owner—who reports over 1,000 visitors—plans to construct another kiln with his own resources. The project made specific efforts to educate and work with local authorities to reduce air pollution while ensuring that brick-makers could generate livelihoods. It began a dialogue with policy-makers from the start, making their improved awareness and understanding of energy and pollution issues a very important element of the project. A new government policy aims to phase out the traditional kilns and the new technology appears to offer one of the most viable means of doing so. This project thus provides a practical demonstration supporting national policy and global environmental objectives while responding to local concerns. It has also demonstrated the power of trans-boundary technology transfer. The project is also expected to link to a full-sized GEF energy efficiency project. Given the large scale of the brick-making industry and its highly dispersed nature, there is a great benefit to the country as a whole to test such technology on a small scale and in conjunction with local officials and community members. The project has developed the capacity of TTSA to manage environmental projects and work with local stakeholders. In addition, local government officials are gaining additional knowledge and understanding of energy and environmental issues related to the brick kilns.

2.5.9 Financial barriers

Finding the resources to finance ideas and projects that promote energy efficiency and especially renewable energy is most often cited as the main barrier to adoption. As a result, many SGP projects have sought to stimulate adoption of renewable energy technologies through innovative finance or credit mechanisms that take into account the scale and absorptive capacity of the community. See case study 18 about an SGP project, which is financing the commercialization of a rural solar electrification scheme in the Dominican Republic. A more detailed analysis of this subject can be found in chapter three.

Case study 18
Financing and commercializing a rural solar electrification scheme in the Dominican Republic

Background: The Asociación para el Desarrollo de Energía Solar (known as ADESOL or the Association for the Development of Solar Energy) seeks to remove financial and technical barriers to the spread of solar home systems in the rural areas of the Dominican Republic. ADESOL, along with its US-based partner Enersol, have developed a model for promoting solar technology called the Solar Based Electrification Concept, or SO-BASEC. Based on the belief that those who benefit from solar electricity are its most important promoters, this model promotes small businesses and decentralized financing systems that enable rural people to learn about and pay for their own solar panels. This guarantees them full ownership of and responsibility for their electricity use, and at the same time enables many more people to access the solar technology. ADESOL believes that it is better for end users to pay the full cost of the solar home systems because this will help ensure the development of a sustainable market for the technology. *The Rural electrification based on solar energy in the Dominican Republic* project was implemented by ADESOL with an SGP grant of $20,500 in 1994. The grant resulted in 104 systems financed through a revolving loan fund and 192 direct sales.

Project objectives and implementation: ADESOL's work began by demonstrating rural residents' willingness to pay for the technology. Grant funds paid upfront costs for a small number of homes to obtain the panels. Through a deposit of approximately $115, residents could pay off the loan at about $6 per month, which was less than the amount that they used to pay for batteries and kerosene. A revolving fund has now been

established to finance more than 600 solar home systems in marginal rural communities in 18 of the 30 provinces in the country. At the same time, ADESOL trains rural residents as entrepreneurs who can run small businesses selling the solar home systems. These new small enterprises form the Solar Network, which is made up of 16 micro-enterprises. Finally, ADESOL supports community installations, including solar water pumps and lighting for schools, health centers, community centers and parks.

Financing: ADESOL has found revolving credit funds to be an effective way to maximize the impact of its own limited financial resources. ADESOL extends loans to end users, who in turn purchase the solar home system from one of the micro-enterprises in the Solar Network. The end user pays back the loan over no more than two years. The solar panel itself is used as collateral for the loan. While some solar panels have been removed from homes for lack of payment, the end users always started paying again and the panel has been replaced. ADESOL's loan arrears rate is very low at approximately three per cent. Another method ADESOL has employed to leverage funds is to take some funds from the revolving fund and place them in a US bank account. This "fondo solar" now acts as collateral for ADESOL or another NGO to request a loan from a local bank, and then in turn extend loans to end users. While the bank required 100 per cent collateral funds for ADESOL's first such loan, the next time it only required 80 per cent. Thus, the bank began to assume partial risk in the loan.

Benefits and impacts: ADESOL has demonstrated that with effective financing mechanisms, rural Dominicans are willing to pay for solar-powered electricity. Several lessons have been learned along the way: a) a decentralized network of solar home system micro-enterprises reaches more communities. Each micro-enterprise is independent and can make its own decisions about how to best reach their particular communities. Yet at the same time, by linking them together through the Solar Network, they gain access to the financing mechanisms managed by ADESOL. In addition, ADESOL maintains strict quality standards for solar home systems, and periodically audits bookkeeping to help avoid billing errors. b) A fixed interest rate for loans helps protect funds from money devaluation. ADESOL uses a fixed rate of 30 per cent, while for the past ten years Dominican pesos have lost 14 per cent of their value each year. c) Clients must have a minimum level of income to repay the loan. The micro-enterprise performs a client evaluation before a loan is made, and the client must demonstrate some earnings potential. d) Payment schedules can be set according to the type of income-generating activity available in a region. For example, a cattle-raising district will have a monthly repayment scheme, while agricultural zones have payment schemes timed with the harvests.

With the support of SGP, Costa Rica's Sol de Vida Foundation has established a research centre to promote the different uses of solar energy. Solar creativity workshops have been organized so that families can sample food made in solar kitchens, exchange recipes, learn about technical issues such as photovoltaic cells and drip irrigation, and even introduce their children to solar-powered toys.

3.1 SGP "learns by doing"

While carrying out climate change mitigation activities over the past decade, a range of experiences and approaches has emerged from SGP projects. These are presented in this chapter, based on the findings of the climate change portfolio review. They are categorized as follows:

- Linking global environmental objectives to local benefits.
- Flexible and innovative financing.
- Incentives, ownership and capacity development.
- Complementary partnerships.
- Adapting technologies and approaches to local circumstances.
- Building new markets or taking advantage of existing markets to improve livelihoods.
- Exploiting synergies between the UN conventions relating to management and use of natural resources.
- Providing indirect subsidies to support commercialization of project activities.
- "Learning by doing": incorporating lessons into the development of new projects.
- "Scaling up" to extend project impacts.

3.2 Analysis of experiences

3.2.1 Linking global environmental objectives to local benefits

SGP projects incentivize communities to participate because they provide important energy services despite focusing on global environmental objectives. It is a simple equation. The greater the benefits to the community, the greater the time, energy and support a community will devote to environmental activities. The more support the project receives, the greater the reach, impact and sustainability of the project. Energy services derived from climate change projects therefore link environmental objectives with local (and global) benefits.

Generally, all SGP climate change projects deliver some form of energy service to the community. Energy services enable a range of daily yet critical activities in households and the wider community. Communities require energy services to meet their basic domestic, community and commercial needs, including cooking, lighting, heating, irrigation, water pumping, sanitation, health and education services and productive end-uses. The provision of energy services depends on partnerships between communities and a range of development sectors.

Experiences from SGP community initiatives reveal that climate change and the provision of energy services generate critical cross-sectoral benefits at the sub-national and national levels. Activities supported by SGP to help communities mitigate climate change are inherently integrative and promote multi-sectoral approaches.

"Before SGP, our principal sources of livelihood were cutting firewood from the carob trees of the dry forest to sell or leaving our families to find unskilled work in Chiclayo [the state capital]. I began to wonder what would happen once there were no more trees, and I began to worry. Fortunately, SGP came to help us take care of the trees in ways that could generate income through honey and cattle fodder, while ensuring the natural regeneration of the forest. This helped me to earn an income for my family without having to travel to Chiclayo to look for work. Pumps and improved stoves now allow us to live better—we have water, which is very scarce in this ecosystem, and the stoves have improved the health of our wives and children by reducing the amount of smoke produced as well as the amount of firewood needed"
—*Don Emilio, peasant extension agent, Jayanca, Lambayeque, Peru*

Case study 11 examines the approach pioneered by the El Limón micro-hydropower project in the Dominican Republic to generate cross-sectoral benefits. The integration of SGP climate change activities in other development sectors has only been possible through partnerships and collaboration at every stage and at every level.

3.2.2 Flexible and innovative financing and credit

SGP has supported a wide range of financing and credit options in support of community-driven climate change mitigation activities. These fall into the following categories:

- Financing/credit facilities for community members who cannot pay high upfront costs, but who have some capacity to repay by cash installments.
- Financing/credit facilities for those associated with commercial or semi-commercial energy activities, such as small-scale energy equipment producers or suppliers.
- Financing/credit facilities for the very poorest members of a community who cannot raise small monthly cash payments for energy services or products, but who can repay in-kind.

Financing community activities by helping them to access existing loan systems occurs in situations where community members are able to repay loans by installments. For example, Sri Lankan villagers are able to take advantage of an existing village revolving loan scheme associated with a micro-finance institution, the Giruwapaththu Development Square, to buy small-scale wind systems. The project's use of revolving credit schemes has helped reduce financial barriers to the purchase of the wind systems by building credit resources through local institutions and linking beneficiaries directly with the component manufacturer. Another example exists in Kenya (see **case study 19**) where the Renewable Energy Technology Assistance Programme (RETAP) has arranged for a private manufacturer to supply institutions such as schools with stoves to be purchased by installments over two years.

Case Study 19
Financing the energy-saving institutional stoves sector in Kenya

Background: Approximately 80 per cent of the Kenyan population relies on biomass-based energy for cooking and heating. One set of biomass users is educational institutions (primary and secondary schools, as well as colleges). Of Kenya's 20,000 educational institutions, about 90 per cent use wood fuel to prepare meals. At some schools, children use significant amounts of time searching for fuel wood—time that could otherwise be spent learning. Many schools spend a good deal of money purchasing firewood, which currently costs about US $25/ton in the Mt. Kenya region. The impact of firewood collection on local ecosystems, particularly surrounding Mt. Kenya—a World Heritage site of critical importance and a watershed catchment—is significant. The *Energy-saving institutional stoves* project was implemented by RETAP with an SGP grant of $45,000. The project started in August 2001 and is expected to last three years.

Project implementation: This project seeks to replace open fire cooking systems in schools with heavy-duty, brick-insulated stainless steel stoves, which use 60 per cent less firewood. In doing so, schools save money on fuel costs and in schools where children must collect firewood, children can spend more time studying. RETAP has addressed financial barriers by establishing a credit system, which enables a school to pay off the cost of a stove system over two years. However, since the producers of the stoves are generally small-scale, they require full payment for the stoves at the time of purchase meaning that another source of credit is often necessary to enable schools to make the initial purchase.

Benefits and Impacts: At the time of writing, a total of 100 schools in the Mt. Kenya region have installed improved stoves, and 20 of these with the help of SGP. Prior to installation, each school used an average of about 160 tons of wood per year. The new stoves have saved each school 96 tons per year, making the total reduction in firewood use about 9,600 tons annually. In addition, some schools have begun to plant their own trees (20 schools participating in the SGP-funded project planted a total of 100 acres of forest). Together, the reduced firewood use and increased tree planting reduces carbon dioxide emissions and increases carbon sinks. Schools with the improved stoves spend 60 per cent less on fuel costs. A school with an average of 300 students saves US $1,025 per year gross (excluding the initial purchase of the stove). This means that educational institutions can channel these savings to meet other needs including reducing tuition costs, providing extra instructors or improving facilities. In the past, some schools have also required students to help search for firewood. Where this is the case, these students will no longer have to collect so much firewood, thereby allowing them more time to study. Some schools have also starting planting their own woodlots to grow their own fuel. Since the new stoves use much less fuel than before, the schools are even able to sell excess wood to neighboring schools.

Examples of non-cash micro-credit in Nepal and Tanzania illustrate the final category. A grantee in Nepal has designed a credit mechanism that allows women to knit bags that are sold over the Internet to pay off loans for solar panels. The arrangement, though difficult to implement, has helped poor households in Nepal to access existing government subsidies for solar home systems. This kind of credit mechanism requires NGO support and investment in training to ensure products meet high quality standards for successful sales. See **case study 12** for details.

In Tanzania, a loan scheme known as the Heifer-in-Trust scheme is used to help farmers obtain cows for biogas (dung) production. As a result, the farmers have improved their livelihoods through milk production and agricultural activities using slurry from the biogas units. See **case study 20**.

Case study 20
Promoting use of tubular-biogas digesters in Tanzania

Background: This project began when researchers from Tanzania learned about a low-cost, tubular plastic biodigester being used in Viet Nam. They adapted it to Tanzanian conditions, and then began seeking ways to integrate its use into the farming system. Known as the *Promotion of low cost biogas technology to resource-poor farmers in Tanzania project*, it was implemented by the Foundation for Sustainable Rural Development (known as SURUDE) funded by two separate grants. The first SGP grant was provided in 1994 and the second in 2001. The total support for the 1994 and the 2001 grants is $88,016.

Project objectives and implementation: The biogas digester, which costs between $100-120 and takes about four hours to assemble, requires the excreta from one to two cows, between five to eight pigs or four people on a daily basis. The digester also requires an adequate water supply, ideally operating on two parts water for one part manure. (Water access is a significant problem in some parts of Tanzania, and therefore presents a barrier to biogas technology adoption in some regions). In order to provide a steady supply of manure, those farmers who do not have cows must obtain them. The "Heifer-in-Trust" scheme helps address the financial barriers to obtaining cattle. A farmer is loaned an in-calf heifer, and agrees to give the first two female calves to neighbors. The sale of milk in Tanzania generates significant income relative to the sale of crops, thereby increasing the family's income. In addition, while men control crop income, the income from dairy products traditionally belongs to women. In order to help sustain the cattle, SURUDE promotes tree-planting and sunflower cultivation, which provide feed for livestock but also environmental and livelihood benefits.

Benefits and impacts: The Heifer-in-Trust scheme has been effective in making cattle available to poor farmers. However, financial barriers still hinder the acquisition of relatively expensive biogas systems. Although the system more than pays for itself over time through income generation and savings on fuel purchase, the upfront cost represents a large percentage of many farmers' yearly income. Micro-finance systems must be developed to ensure the spread of this technology. In Turiani, a women's organization called Kamuutu has established a revolving credit fund with support from SURUDE. Each family contributes a set amount of savings per month, and farmers can then acquire credit on a revolving basis. SURUDE has provided training in book-keeping.

Two common characteristics of SGP climate change projects with a micro-finance component are noted:

- The upfront costs of renewable energy goods and services are often high. Paying these costs by installments is popular with beneficiaries. The repayment schedule must take into account the pattern of the income stream generated by the individual or community.
- Credit facilities or revolving funds must remain flexible to enable communities living in varying levels of poverty to repay loans with cash or in-kind.

The use of innovative financial mechanisms and approaches tailored to community needs and pioneered by SGP projects have played a significant role in breaking down financial barriers and helped to distribute SGP benefits evenly across communities.

SGP grants have been used to provide initial seed funding to stimulate new activities or to set up a credit facility or a revolving fund/trust fund. Such flexible approaches are crucial in situations where cost barriers prevent the acquisition of energy-related services and equipment.

Table 6. Summary of innovative micro-finance approaches in SGP projects

Micro-finance approach	Community category	SGP project example
Grants are advanced to an NGO that works in partnership with a micro-credit organization and relevant manufacturers or distributors. A revolving credit scheme is established for the purchase of RET or an energy service	Those endowed with some financial resources that can be invested over time	Provision of institutional stoves in schools and institutions around Mt. Kenya by RETAP
Grants are advanced to an NGO or CBO, which is a member of a reputable network of revolving fund schemes designed to support communities. A revolving fund is established with the network of schemes to finance the purchase of RET or an energy service	Those with some financial resources to invest but insufficient to take risks	Installation of small wind energy systems in Sri Lanka
Grants are advanced to an NGO or CBO working in partnership with local private businesses. An RET trust fund is established to enable the organization to borrow money from local banks. The NGO then uses this money to establish a revolving loan scheme operated by local sales agents to enable community customers to purchase RET. Repayment is made through savings and RET-based commercial enterprises.	Those who can repay loans through accrued savings	Promotion of solar home systems in the Dominican Republic

Micro-finance approach	Community category	SGP project example
Grants to an NGO or CBO working in partnership who advance credit to community members but who are repaid in-kind. The NGO helps the community to market products to recover loans	Those who cannot pay through cash but who can pay in-kind with adequate access to markets	Promotion of solar home systems in Nepal. Payment is by knitting bags, which are sold to recover costs
Grants advanced to an NGO or CBO to install RET schemes aimed at productive end-uses. The NGO or CBO teams up with a credit institution to gain preferential credit facilities to finance the commercial end-uses generated by the energy service	All types of communities	Micro-hydro projects have elements of this approach. The financing targets are com mercial activities powered by the RET

Source: SGP climate change portfolio analysis and review of a cross-section of projects from 1992 to 2002

3.2.3 Incentives, ownership and capacity development

By self-organizing and identifying strategic priorities together, communities develop their capacity to manage change and sustain project activities during implementation and once external funding ends. Incentives provide the necessary motivation for community members to participate in the project process. The ownership arrangements established to manage a project will in many cases serve as an incentive for participation. These arrangements vary from SGP project to project, depending on the objectives, circumstances and approach of each project.

Different types of ownership structures exist in SGP supported projects. These include:

- Common ownership of a power source for communal use. See **case study 5** on the electrification and micro-irrigation project in Cachimayo, Bolivia for details.
- Common ownership of a power source for use by individuals. See **case study 21** on communal solar electricity in Côte d'Ivoire for details.
- Individual ownership of a power source and individual use. See **case study 18** on financing rural solar electrification in the Dominican Republic.

Case study 21
Communal solar electricity in Côte d'Ivoire

Background: Approximately 7 million people living in Côte d'Ivoire's 8,500 villages still have no access to electricity. Through conventional methods of electrification, they cannot hope to have access for another 50 years. The "*Minimum comfort" solar electricity* project was implemented by an NGO partnership involving the Opportunities Industrialization Center, the St. Ignatius Loyola Organization for Economic and Social Study, the Center for Training and Research in Rural Development, and the Programme for Community Health and Development. The project was supported with five SGP grants of $45,103 each and implemented by the partnership during 2001-2002.

Project objectives and implementation: The project sought to test communal solar photovoltaic systems as a low-cost method of electrification of both households and public buildings such as health clinics, schools and community centers. Four NGOs operated in 15 villages with at most 60 households (totaling approximately 500 inhabitants) in five districts, all of which are not included in the country's electrification plans for the next ten years. The NGOs, local populations and elected officials agreed together the locations and priorities of project activities. In one set of villages, they focused on household lighting. Each household needed sufficient income-generating potential to pay for a PV lighting system. As of 2002, each village now covers one third

of the cost of these installations. In a second set of villages, public and household lighting was provided. Existing social welfare committees are responsible for the maintenance of a communal PV system; to make this process manageable, each village was subdivided into groups of no more than ten households. Each subdivision received four 55W panels, totaling 220W per subdivision. Each household received two energy-efficient light bulbs and a plug for audio-visual equipment.

Benefits and impacts: The homes of about 2,000 people, plus 31 public buildings including schools and health centers, benefited from lighting. The reduced use of wood and kerosene in these villages due to the use of solar lighting reduces GHG emissions contributing to climate change. An improved ability to work at night has made it possible for villagers to engage in more income-generating activities, such as spinning cotton and other products of locally grown crops. Lighting has helped promote education in a variety of ways. First, better lighting in schools provides a better environment for learning and second, the existence of lighting in the schools has attracted more teachers. Finally, lighting in community centers has helped to enable greater adult education opportunities.

Problems and challenges: This project tested the feasibility of communal PV systems. While the overall results were positive, some problems were encountered. First, some solar panels were stolen due to "high demand." In addition, users of the electricity tended to increase their demand without taking into account the capacity of the panels. Some villages also had trouble locating spare parts due to the lack of a robust private sector supplying the panels. These problems reveal a few key lessons regarding PV systems, particularly communal ones: a) User rights to solar panels must be very carefully defined and enforced. Limits on the use of electricity must be clear and enforced. The use of excess electricity from communal panels is related to the issue of property rights. Without strong communal sanctions for overuse, or without a technical means of limiting electricity use, each person has little incentive to remain within the agreed-upon electricity use limits. As a result, some households will use more than their share and others will get less. b) Attention must be paid to the development of a market for solar panels. Without such private sector involvement, spare parts are likely to be hard to find, and expansion of existing systems will require the intervention of an NGO. This is true for both individual and communal solar panel systems.

When these cases are compared, the following observations can be made:

- Ownership structures depend on the type of energy service provided and the circumstances of the community. See **Box 6**.
- In all cases, training and education help to empower the community and ensure efficient use and good maintenance of the systems. Common benefits can take time to trickle down to community members. Preventing conflict, anxiety and mistrust between community power management committees and community members is essential.
- Different ownership structures require different incentives to function healthily and ensure proper distribution of benefits. Incentives can include shared dividends in the form of financial gains, employment, access to clean water, household lighting, and increased social capital.
- Where cooperatives or community companies set the power tariffs for electricity use, it is important for this income to be used to pay the salaries of technicians to maintain and operate the system.

Box 6. Community ownership of Tungu-Kabiri micro-hydropower scheme in Kenya
In Kenya, 200 community members came together to form a commercial enterprise to own and operate a micro-hydropower plant. Each individual purchased a share in the company with a maximum value of approximately $50. The members then built a run-of-the-river micro-hydropower system, dedicating one day per week for over a year for construction. With an acre of land acquired by the community from the government, they set up a small business center using power generated by the scheme. A 10-member community power committee manages the day-to-day operations of the plant, and decides via community consultations what additional other services should be provided. In this way, the power committee is effectively playing the role of a village development agency. (See **case study 16** for more information.)

3.2.4 Complementary partnerships

Working in partnership is a core principle of every SGP project. Partnerships enable SGP to capitalize on the synergies that true collaboration can produce, making grants go further and do more. While SGP funding has always been channeled directly to NGOs and CBOs, partnerships have been forged by the grantees with government ministries and departments, research and academic institutions, the private sector, manufacturers and industry, financing and credit institutions, other NGOs, CBOs, the media and donors.

Experiences from SGP's climate change projects show that partnerships have enabled local communities to achieve global environmental benefits while generating livelihoods and employment opportunities. New frontiers in community development, built on GEF funding criteria, have opened up. Partnerships have helped to:

- Educate the broader community about the benefits of demonstration projects.
- Increase and enhance policy impact (see **Box 7**).
- Leverage additional resources and attracting co-financing (see **Box 8**).
- Integrate renewable energy priorities into other development sectors.
- Bring together a range of partners to perform specialist tasks given the diversity of challenges relating to projects, communities and/or technologies.

An example of partnerships to educate the broader community is illustrated in **case study 4** on the *Clean rivers project* in Kazakhstan.

Box 7. Partnerships promote policy impact in Poland
The Poland biofuel project (small-scale production biofuel from rape-seed for farming) has resulted in renewed efforts to eliminate policy barriers to the large-scale production of biofuel. The partnership involved the industry in the design and manufacture of a portable rapeseed biodiesel processing unit. By working with a company, PROMAR, the project has helped build allies in the industrial sector for the removal of the tax on biodiesel. Campaigning by environmentalists and industry has helped put a bill before the Polish Parliament to support biofuel activities.

Box 8. Partnerships leverage additional resources in the Philippines
In the Philippines, government involvement has enabled a community to protect a watershed needed for micro-hydropower. The authorities provided tree seedlings and expertise related to watershed conservation while an NGO provided the community with the necessary micro-hydropower technology and community members provided labor. (See **case study 10** for more information).

3.2.5 Adapting technologies to local circumstances

Local circumstances generally require communities to adapt available technologies to meet their specific needs and priorities. The following represent some of the situations that lead communities to adaptation.

3.2.5.1 Climate

Weather conditions may necessitate the adaptation of conventional technologies to local circumstances. The process may result in new renewable energy equipment designs. In Kazakhstan and Kyrgyzstan, for example, biogas technology had to be adapted to cold weather for the project to succeed. To maintain sufficient temperature, the biogas systems are either connected to the house's heating system or in the case of Kyrgyzstan, waste energy from the hybrid hydro-biogas system is used for pre-heating the digesters. Large digesters use about ten per cent of the produced biogas to maintain a proper temperature. This project has produced technical lessons about adapting biogas to cold-climate countries.

On the other hand, in Tanzania, the same technology had to be adapted to low water availability. Biogas use in Tanzania is sometimes hindered by a lack of sufficient water. SURUDE has been working with Sokoine University to develop designs that use less water, or include rainwater catchments systems to ensure greater adoption of the technology (see **case study 20**).

3.2.5.2 Sector-specific concerns

Certain sectors require a unique approach. In Poland, the small-scale rapeseed oil production of biofuel used in farm tractors required the development of a versatile, simple, safe and portable unit for deployment in local farms. In normal circumstances, biodiesel is produced in factories in centralized production facilities. In Sri Lanka, conventional wind turbines had to be adapted for use in small household-managed wind systems. The Building and Construction Improvement Programme (BACIP) project in Pakistan titled *Adapting technologies to local circumstances and efficiency improvements* has introduced new building, heating and cooking techniques and materials in mountainous remote villages. Employment has been boosted by the development of a new market to produce and install new energy efficient materials. This project depends on the production of local materials by local artisans who are able to take the new techniques that they learn and integrate them into future jobs. Sixty home improvement products have been developed as a result of this project, and SGP funds are helping train local entrepreneurs to build and disseminate several of them.

3.2.6 Building new markets or taking advantage of existing markets to improve livelihoods

New markets are the engines for sustaining environmental activities. Livelihoods benefits are the incentives for achieving environmental benefits. Project experiences show that SGP grants are used by some projects to create the conditions necessary for the commercialization of renewable energy technologies and services. Experience shows that these new markets have not only been developed for the sale of goods produced from energy services (for example, from micro-enterprises or commercial activities), but also for energy services and equipment (for example, the repair and production of energy equipment and services to maintain and service the equipment or schemes). It has proven important to work with communities to strengthen existing or establish new products or services that build a critical mass of services and goods.

A most interesting new market is the market for credit provision. Within the financial sector, this has become a pioneering market with particular benefits for communities. Markets have been built in Kenya (refer to **case study 19**), Sri Lanka and the Dominican Republic (refer to **case study 18**) for the purchase of institutional stoves, wind energy and solar home systems respectively. The market is interesting because credit provision for renewable energy activities has not been popular with general credit providers especially where the credit

involves communities or small and micro-enterprises. However, with successful experiences emerging from SGP projects, the sector is starting to support fledging renewable energy related commercial activities.

Supporting producers or providers of energy goods and services through the development of appropriate local formal standards for new products is also important. In some SGP participating countries, there is a lack of formal standards for goods and services relating to solar energy systems, community micro-hydropower systems, small wind energy, biogas and also improved stoves and kilns. Lack of standards in some cases has resulted in sub-standard goods or services leading to skepticism about the technologies and low adoption rates.

3.2.7 Providing indirect subsidies to support commercial ventures

A subsidy in this context can be defined as the indirect support provided by SGP to grantees to promote commercial ventures. This support does not interfere with market activities relating to energy services and products. It can take the form of training and capacity development, product or service awareness campaigns, or risk insurance in situations where credit facilities are involved. Activities that indirectly support commercial activities are especially important when the market is young and new.

SGP experience indicates that subsidies should be as indirect as possible to avoid market distortions. In the Dominican Republic, for example, SGP funded projects avoid reliance on direct subsidies. Seed money provided by SGP has stimulated the establishment of a revolving fund for provision of credit on a sustainable basis and the formation of a national solar network. Individuals can now pay the full costs of acquiring a solar home system and demand for these products has been established to help sustain the activities of the micro-enterprises dealing in solar equipment.

3.2.8 Exploiting synergies between the UN conventions relating to management and use of natural resources

SGP seeks to implement the environmental objectives of the GEF set out in the UN conventions and agreements relating to its current mandates and obligations. Areas covered include climate change, desertification and land degradation, biodiversity conservation and sustainable use, protection of international waters, and the elimination of persistent organic pollutants. Enhancing linkages between the activities designed to implement these agreements and the implementing partners will enhance the sustainability of projects. For instance, where climate change mitigation initiatives require action that supports biodiversity objectives (such as micro-hydropower schemes that require the protection and conservation of river catchment areas), synergies should be exploited. **Case study 10** demonstrates an SGP project in the Mindanao Islands in the Philippines, where the relationship of watershed management and the operation of the community micro-hydropower scheme was recognized and incorporated into the design of the project.

3.2.9 "Learning-by-doing": incorporating lessons into the development of new projects

Learning-by-doing is a process that SGP country programmes use to help communities strengthen their projects, building on existing processes and mechanisms. The process is incorporated into the monitoring and evaluation framework of SGP projects and the outputs are used to inform and improve the management and support given to communities by SGP country programme teams. Lessons learned from one project feed and inform the strategy and implementation of another. For example, SGP Mexico improved the design and development of eight different community projects between the months of February and August 2002 by taking into account lessons from previous projects ranging from technical aspects of projects to approaches to communications and capacity development.

Learning-by-doing is predicated on a willingness to use adaptive management. Failures can be as instructive

as successes. A number of SGP projects have experienced failures in some cases and near-failures in others. The nature of the failure is determined by whether a project is able to recover or must stop operations. For example, the wind turbine project in Kazakhstan began well in 1998 with a grant of $25,000 to the Ana-Ymiti NGO, but six months after installation, the turbine developed a technical problem and was left un-repaired. In this case, the community faced two challenges: a) a lack of local partners to repair the turbine; and b) poor equipment in the first place. The producer of the turbine was not able to provide any technical support to the community to help fix the problem, while the community did not have the financial or technical capacity to repair it themselves. Lessons from this experience have led to efforts to strengthen the capacity of the sector to avoid such failures. Currently approved projects include activities to build capacity to produce, install and maintain equipment.

There are many examples where such problems have occurred but have been effectively resolved through capacity development. In Sri Lanka, the Kirinda small wind system project provides electricity to rural households in a coastal village of Sri Lanka. Initiated by a local NGO Manawa Sampath Surakum Sanvidhanaya and supported by an SGP grant with technical help from ITDG in Sri Lanka, the project resolved problems with the equipment stemming from corrosion associated with the salty environment. The essence of "learning by doing" is to see failures and near-failures as necessary steps to promote successful outcomes.

Linked to the process is the use of communication as a tool for capacity development and for sharing information with others about what has and has not worked. Between August 2002 and February 2003, SGP India conducted ten activities to improve communication with development partners and communities. They included one-on-one meetings, thematic workshops, sessions for orientation, consultation, and stakeholder brainstorming, and participation in special environment days. These events were important for encouraging more proposals from eligible grantees, experience sharing and knowledge exchange.

3.2.10 "Scaling up" to extend project impacts

While SGP activities are small-scale, the benefits and impacts often ripple out beyond the project area. The magnitude of reach depends on the project, the approach, the technologies utilized, the partnerships and the influence of the project on beneficiaries. Scaling up occurs on two levels. The first refers to the expansion of project approaches and impacts to other communities by replication, at a national or regional level. The second level refers to the expansion of project approaches and impacts by enlarging the project itself, such as becoming a GEF medium-sized project.

Whatever the direction, the scaling up process benefits from the experiences and lessons that emerge from the original activities. In many SGP participating countries, examples of projects expanding from one community to others can be found. **Case study 3** refers to the prospects for expanding a project promoting solar energy for the drying agricultural crops and medicinal herbs project in the Occupied Palestinian Territories with support from CIDA and the German Fund for Palestinian NGOs. **Box 9** provides an example of scaling up an SGP project to become a GEF medium-sized project.

Box 9. Polish biomass project scales up to become a GEF medium-sized project

An SGP grant for a biomass demonstration project in Poland shows what is possible. An experienced urban NGO, the Barka Foundation, has used technical innovations to demonstrate the feasibility of using woody wastes from urban green areas as biomass fuel by introducing a biomass-based heating system in the offices of the Municipal Gardens Company (MPRO) in one of Warsaw's urban parks. The project was to develop a 100 KW fluidized-bed boiler adapted to biomass from urban green areas that can be used for coal-fuel conversion in other parts of Warsaw and in other Polish cities. This project was expected to reduce the volume of biomass waste disposed in landfills, reduce air pollution in one of Warsaw's major parks by replacing coal with biomass fuel, achieve significant cost savings for MPRO which has responsibility for managing green areas, develop an awareness that biomass is not a waste but a resource by demonstrating the market potential and cost-savings of using biomass fuel, and develop institutional arrangements for scaling-up the project in Warsaw and other cities. Feasibility studies suggested that the 14,000 m3 of wood waste generated annually in Warsaw would allow 80 such boilers to replace 1,900 tons of coal fuel annually and so significantly contribute to the reduction of emissions of greenhouse gases.
Source: Second Independent Evaluation of SGP, 1998, page 39

Four years later, a quote from the Third Independent Evaluation of SGP indicates the following. The Integrated Approach to Wood Waste Combustion for Heat Production project in Poland has achieved a 66 per cent reduction in carbon dioxide emissions compared with prevalent technologies based on coal. This innovative approach, reviewed during the 1998 evaluation based on a low cost environmentally friendly technology that replaces coal-fired furnaces, was initially implemented by the Barka Foundation as an SGP project that directly supported poor families. The project has subsequently been scaled up to become a GEF medium-sized project and is being replicated by other Polish institutions following widespread dissemination of its positive results.
Source: Third Independent Evaluation of SGP, 2003, page 23

A community member with the solar panels that are used for pumping water for irrigation and drinking in a village in Thailand.

Chapter Four Ten Lessons Learned

The approaches and experiences presented in previous chapters reveal the following ten practical lessons:

1. Local benefits stimulate global environmental benefits.
Global environmental benefits are enhanced when local benefits are generated. The greater the options for better lives and livelihoods, the greater the importance attached to an environment project by a community. The portfolio review concludes that the most highly rated initiatives are those that increase the diversity of livelihood options while sustaining the use of basic assets such as land or water and providing energy services.

2. Sustainable solutions to climate change or energy problems are those that are owned by the community.
The experiences highlighted in this publication show that sustainable solutions to climate change or energy problems most often emerge from within. Communities routinely invent or improve and adapt existing, practices or technologies to fit their own situations and meet their most pressing needs. The provision of modern energy services which meet basic community needs is the main incentive for community engagement in activities to mitigate climate change. The most effective solutions address the need for a specific energy service—every community is different. The types of energy services required by communities differ from region to region. They include such items as power for cooking, lighting and productive end uses such as water pumping, house heating and drying.

3. Capacity development promotes integration and sustainability.
Capacity development is described by UNDP as "those activities which assist individuals, groups and organizations to increase their abilities to perform core functions, solve problems, and define and achieve objectives." [23] Capacity development within the context of SGP projects is a complex concept, occurring across levels and sectors.

With a sectoral focus on climate change abatement and the achievement of global environmental objectives, SGP requires capacity development at a technical level. For example, where a community operates a micro-hydropower plant, the capacity of individual technicians and management teams may need to be strengthened to ensure maintenance of the scheme and develop tariff setting. The capacity of manufacturers, component repairers and feasibility assessment specialists is also an important consideration. At the societal level, the surrounding community may need to understand better the linkages between effective management of local water catchment areas and the operations of the scheme, and be able and willing to adapt their daily activities and traditions to protect them. At the institutional and system levels, issues relate to policy and legislative change, ownership structures, strategies and inter-organizational cooperation, financing and the enforcement of official standards.

With the needs and priorities of the local community at the heart of all SGP activities, an integrated approach to capacity development, which strengthens the relationships and dialogue between villagers and their self-appointed leadership structures, local and national institutions, civil society, the media and the private sector is the most effective. The willingness of SGP to delegate responsibilities to grantees and partners is a core factor.

More than a financial partner, SGP is a tool for mentoring and capacity development, which encourages communities to think about their problems relating to climate change in order to find solutions that are appropriate for their context. Their projects constitute, for them, natural laboratories for experimentation. With SGP, communities themselves take charge of the funds and carry out and provide justification for expenditures. Even better, it is they who pay for the technical services responsible for monitoring their activities. Paternalism has been replaced

23. Management Development and Governance Division, Bureau for Development Policy, UNDP (1998), Capacity assessment and development: In a systems and strategic management context (UNDP Technical Advisory Note No. 3), United Nations Development Programme, New York.

by handing responsibility to small farmer organizations, which establish local project management committees that work very well. SGP serves as a trigger for active partnership. This is a very important innovation—Hamidou Benoit Ouédraogo, President, Burkinabé Association of Action-Research and Self-Teaching for Development, and member of the SGP National Steering Committee, Burkina Faso

4. Complementary partnerships are crucial for effectiveness.

The provision of energy services is a multi-sectoral process, requiring the support of different development sectors, including water, agriculture and micro-finance, among others. Grantees have learned to exploit synergies between these sectors by forging partnerships with development partners, including other GEF projects, UNDP initiatives and development networks as well as other local actors. Generally, partnerships lead to the co-financing of complementary activities related to climate change projects. In some instances, climate change activities are supported by partnerships focused on research, especially where new technologies are being introduced for the first time or are being developed and tested by a community.

Partnerships also play an important role in sustaining project activities or the impacts of a project after funding from SGP ends. All partners are engaged right at the start of a project to build long-term commitment and vision. While SGP considers grantees as the core partners of a project, others include national and local government agencies, the private sector, the media, bilateral donors, foundations, universities and research institutions, international NGOs and national environment funds. Encouraging partners to participate in the design, implementation and evaluation of projects catalyzes the important process of "learning-by-doing". Partnerships stand at the core of any SGP supported initiative.

5. Adapting technologies to suit local conditions is a process.

The adaptation of technologies to suit local circumstances generally requires training and capacity development to enable the manufacture, marketing and sale of the revised products in an established market. Before new technologies are introduced to communities, it is essential that an assessment be carried out to gauge existing capacity and understand what is needed to adapt to the proposed changes. Improvements to conventional technologies should not be too drastic to give the market, the manufacturers, technicians and purchasers the chance to adapt to the new design and utilization requirements. Experience shows that projects can fail to recover if a technical problem occurs where the adaptation is drastically different from the prior technology and there is no in-built capacity to fix the problem. If there is a failure, the project partnership should be in a position to apply adaptive management aspects in order to repair the technology.

6. Financing options should fit the scale and scope of community objectives.

The sustainability of SGP projects depends strongly upon matching financing options with the specific circumstances of a community. The options preferred by SGP climate change projects include micro-credit, revolving funds, micro-financing including loans that are pegged against community income regimes (such as crop harvesting cycles) and normal conventional loans which are financed by cooperatives that give better repayment terms than conventional banks. As a first step, a strong relationship between the SGP grantee (most often an NGO or CBO) and the community is needed to guarantee effective disbursement and utilization of the grant provided by SGP. Trust is a core component of any project at the community level containing financial risk.

7. To develop new markets and products, build a critical mass of purchasers and users.

The sustainability of climate change initiatives with commercial objectives is enhanced when the capacity of a community to manufacture products is balanced by a critical mass of potential users (or buyers) of the end

products. Flexible methods for providing credit are important and examples include targeted purchasing arrangements[24] and producers' cooperatives.

But access to credit is only half of the story. Ensuring the development and maintenance of high quality goods and services to sustain new markets and facilitate repayment is the other. Lack of a critical mass to sustain demand reduces the momentum for the manufacture of new products. It is therefore important to pay attention, prior to establishing new markets, to those factors that limit the manufacture or production of energy equipment as well as its use (goods and services). Supporting the entire supply chain from consumers to manufacturers and producers to providers of goods and/or services is essential. Indirect subsidies, such are those related to capacity development and awareness raising, can prove to be a valuable tool when attempting to build new markets. However, SGP experience indicates that they should be as indirect as possible to avoid market distortions.

8. "Learning by doing" enhances management and ownership.

"Learning by doing" depends on the capacity of project partners to collect, analyze and store information at every stage of implementation, and to manage and share the knowledge generated in the process. An effective participatory monitoring, evaluation and learning framework is therefore critical. Failures or near-failures most often provide the richest source of lessons and should be seen as important steps towards success. Applying adaptive management as a way of encouraging critical reflection is essential. SGP country programmes have implemented climate change projects for varying numbers of years. With accumulated knowledge, country programme teams have used the lessons and experiences from previous projects to feed and inform the design of new projects[25].

9. Communication is the lifeblood of a project.

SGP climate change projects involve a long-term process of change. To be effective, a project needs to be participatory, integrative and interactive. A range of partners (including government, community, civil society and private sector representatives) must establish relationships and communicate to discuss challenges, identify problems and correct courses of action. These tasks depend critically on awareness, trust, coordination and dialogue. Without communication—which strengthens cooperation and collaboration—the reach and impact of a project is compromised. On another level, the press and media play an important role in supporting the activities of various SGP countries by raising awareness of available technologies and techniques, building support for project activities, and lobbying for policy or legislative change.

10. Community climate change projects can be scaled up.

SGP's climate change projects offer excellent lessons for scaling up as they occur in very diverse cultural, social, economic and geographic settings. They are often small in size, time-bound, flexible, highly interactive and participatory. Since they are also usually low budget pilot projects, there is space for "trial and error", which make SGP projects potentially easier to learn from than larger projects that are more risk-averse and bureaucratic.

24. Targeting a sub-sector (for example, schools and hospitals), which is dependent on a specific technology, equipment or service.
25. SGP country programme teams are required to submit semi-annual programme reports, which must indicate how lessons learned from previous projects are incorporated into the design and implementation of new projects.

In Kenya, SGP has sponsored a community micro-hydropower project in collaboration with NGO Intermediate Technology Development Group. Members of the project, which is wholly owned by the community, will set their own tariffs and sell the power to local trades, and use the electricity to meet basic needs, including charging batteries, welding and joinery, maize grinding, garment tailoring, oil processing and many other micro industries.

5.1 The way forward

People's initiatives are the driving force of change. It is clear that SGP serves as an important and unique mechanism for supporting locally-led, grass-roots action to respond to climate change.

The review and analysis of SGP's climate change portfolio suggests that SGP and other development partners should bear in mind these future challenges and directions:

5.1.1 Serve a broader range of community needs dependent on energy services through climate change abatement projects.

A future challenge for SGP and other programmes is to serve a broader range of community needs dependent on energy services while implementing climate change projects. Communities do not exist in "sectors" or "compartments". Their needs cut across many different development sectors and are best met by cross-sectoral or integrative approaches. The livelihood approach is emerging as the preferred response by projects to the demand for services.

5.1.2 Engage more partners from different development sectors in community projects.

Local benefits are manifested largely in the form of energy services or livelihood benefits, but usually require the participation of stakeholders from other sectors to provide complementary services that are important for sustainability, such as credit or some type of financial support to make a project commercially viable. The consequence of this form of integration is the necessary involvement of many more partners from other development sectors in different aspects of projects requiring tight coordination.

5.1.3 Exploit the synergies between UN conventions relating to the management and use of natural resources.

The SGP portfolio seeks to implement the environmental objectives of the GEF set out in the United Nations conventions and agreements relating to climate change, desertification and land degradation and biodiversity conservation and use, among others. It also contributes to efforts to help developing countries achieve the MDGs through the provision of energy services to meet basic needs. Enhancing linkages between activities designed to implement these agreements and between implementing partners will improve the sustainability of projects and strengthen their focus and reach. SGP has learned that the most effective approach to enhance synergies is to incorporate all partners in the project from the very start. This builds commitment from the earliest stages and eliminates the possibility of wasteful duplication.

5.1.4 Take advantage of globalization by anticipating and breaking down barriers to community engagement.

Climate change activities at the community level are vulnerable to international decisions, especially those that relate to trade and investment in the energy sector. As more international companies enter the energy sector of developing countries, the greater the need to break down policy and legislative barriers that inhibit operations while enforcing regulations that protect local populations and ecosystems. Policies and legislation that support the participation of communities and small investors in producing and distributing power, and developing and disseminating renewable and energy efficient technologies need to be strengthened.

5.1.5 Contribute to the achievement of the GEF's strategic climate change objectives while responding to community needs.

In the future, SGP and its partners will contribute to achieving the strategic priorities laid out by the GEF for climate change activities during the course of 2004 and 2007. These include:

- Transformation of markets for high volume energy efficient products and processes to catalyze both demand and supply with relatively small resource inputs resulting in a significant and lasting market penetration or transformation.

- Increased access to local sources of financing for renewable energy and energy efficiency to provide capital for investment in the commercial energy efficient, energy conservation or renewable energy technologies for modern services.
- Promotion of power sector policy frameworks that support renewable energy and energy efficiency.
- Promotion of productive uses of renewable energy that generate income and stimulate other essential services by the application of renewable energy technologies.
- Aggregation of the global market and support for national innovation for emerging technologies to support the reduction of cost in the long run for the emerging clean energy technologies.
- Modal shifts in urban transport and clean vehicle/fuel technologies to promote public mass transit, non-motorized transport (such as bicycles and pedestrian areas), and non-technology measures (such as traffic demand management and economic incentives).

The promotion of environmentally sustainable transport modes will prove an interesting challenge. Communities' demand-driven preferences are sometimes addressed not only by ground transport, but also by water transport, which involves both motorized and non-motorized modes. While sustainable transport activities have so far only amounted to two per cent of SGP's overall climate change portfolio, the number of projects focusing on sustainable transport is steadily increasing. The future for supporting bicycle transport[26] infrastructure for communities has great potential as it appears to be the preferred intervention.

5.2 Conclusions

The experiences and lessons of the SGP climate change portfolio reveal that NGOs and community groups contribute cumulatively to climate change abatement. Community by community, local populations in diverse locations are developing solutions to address global environmental problems through innovative livelihood strategies. With SGP support, the adaptive capacity of local communities in developing countries to cope with the negative impacts of climate change is improving.

SGP's work proves that local communities remain an essential constituent in meeting the mandate of GEF and the commitments of industrialized and developing nations under UNFCCC. This publication demonstrates that SGP effectively enables the GEF to address the obligations of the UNFCCC by reaching out to and empowering communities.

The publication also shows that climate change activities serve as an important entry point for interventions designed to help communities and countries fulfill their international commitments. SGP helps communities meet their basic need for energy services, preparing the ground for the achievement of the MDGs and the UN environment conventions. Although climate change is essentially a sectoral entry point, solutions to problems relating to climate change are inherently integrative and permeate other sectoral development activities. Through climate change activities, SGP's global network of community grantees, projects and partners contribute to eradicating extreme poverty and hunger, achieving universal primary education, promoting gender equality and empowering women, reducing child mortality, improving maternal health, combating HIV/AIDS, malaria and other diseases while contributing to global environmental sustainability. SGP is committed to improving and expanding this network to address community priorities using climate change abatement as an entry point.

26. Related activities may include the manufacture of components, trade, distribution, taxation policy and development of bicycle routes and paths both in urban and peri-urban areas.

Engaging local populations to protect the environment requires an integral understanding of how communities manage change and the specific needs of each community. Community action to respond to the challenges of climate change and protect the environment depends on the willingness of people with the least resources to commit precious time and effort to activities that generate local benefits and, ultimately, global environmental benefits.

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Useful web sites

The Climate Change Knowledge Network, hosted by the International Institute for Sustainable Development (IISD): http://www.cckn.net

GEF implementing agencies:

UNDP www.undp.org/gef
UNEP www.unep.org/gef
World Bank www.worldbank.org/gef

GEF Secretariat web site www.gefweb.org or www.thegef.org

Intergovernmental Panel on Climate Change: www.usgcrp.gov/ipcc
Intergovernmental Panel on Climate Change document on Climate Change 2001:Working Group II: Impacts, Adaptation and Vulnerability. http://www.grida.no/climate/ipcc_tar/wg2/340.htm

SGP global web site: www.undp.org/sgp

SGP database: www.undp.org/sgp +login

SGP country programme web sites:

Albania www.gef-sgp.org.al
Bolivia http://www.pnud.bo/ppd
Belize http://www.gefsgp.org
Costa Rica http://www.nu.or.cr/gef
Dominican Republic http://www.pnud.org.do/proyectos/pps/index.html
Ecuador http://www.pnud.org.ec/ppd
Honduras http://www.undp.un.hn/PPD_intro.htm
India http://www.sgpindia.org
Kazakhstan http://www.gef.sgp.nursat.kz
Lithuania http://www.undp.lt/sgp
Malaysia http://www.undp.org.my/sgp
Mali http://www.malifem.net
Mauritania http://www.undp.mr/sgp/
Pakistan http://www.un.org.pk/gef-sgp.html
Philippines www.undp.org.ph/sgp/home.htm
Poland http://www.undp.org.pl
Peru http://www.sgpperu.org
Trinidad and Tobago http://www.undp.org.tt/gefsgp/gefsgp.html

SGP grantee/partner web sites:

Alternative Energy Promotion Centre web site. See http://www.aepcnepal.org/sp/se.php.
Enersol Inc. See http://www.enersol.org
Himalayan Light Foundation web site. See http://www.hlf.org.np.

United Nations Development Programme/Local governance: http://www.undp.org/governance/local.htm
United Nations Framework Convention on Climate Change: http://unfccc.int/

World Energy Outlook:
http://www.worldenergyoutlook.org/weo/pubs/weo2002/EnergyPoverty.pdf

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