# Improving Energy Efficiency through Building Materials, Pakistan

## Themes

★ Energy Efficiency
⁕ Linkages with other environmental goals
⁕ Innovative technology applications
❖ Financing mechanisms and private sector involvement
❖ Technical capacity development
✷ Poverty alleviation (MDG 1)
✷ Health (MDG 4-6)

## PROJECT DATA

**Project Name:** Building and Construction Improvement Program
**Implementing Organization:** Aga Khan Foundation – Pakistan (NGO)
**Project Location:** Nathiagali and Gilgit areas, northern Pakistan
**SGP Contribution:** $50,000
**Start Date:** April 2002

## ENERGY OVERVIEW

**Energy Resource:** biomass
**Technology:** roof hatch window, fuel efficient stove, water warming facility
**Application:** cooking, heating
**Sector:** residential, commercial (construction sector)
**Cost of technology:** $17-31 (roof hatch window); $10-$19 (fuel efficient stove); $33 (water-warming facility)
**Number Served:** 62 entrepreneurs trained to produce BACIP products; 7 businesses established to sell BACIP products; 135 promotional models installed; activities in 13 villages

## BACKGROUND

The area targeted by this project includes Northern Areas, Chitral and Nathiagali region of the high mountain ranges of Hindukush,Karakoram and Himalayas of Northern Pakistan.The target area is spread over 74,000 square kilometers with a total population of about 1 million.The region experiences very cold winters, with temperatures falling to –30 °C. Biomass is the primary source of energy. Women and children spend significant periods of time searching for fuel wood and other biomass for cooking and heating, which places immense pressure on local ecosystems.Heavy biomass use also generates smoke, leading to poor indoor air quality and related health problems. Traditional houses in these areas are dark, smoky, unventilated and damp. They also have poor storage and sanitation facilities. Much energy could be saved, and livelihoods greatly improved, through the improved use of space and different building and cooking techniques.The Building and Construction Improvement Programme (BACIP), a project of the Aga Khan Housing Board in Pakistan, has been conducting applied research since 1997 on improved products and building techniques to address these problems.The challenge remains, however, to make these products accessible to local residents and integrate them into local patterns of life.

## PROJECT DESCRIPTION

### Overview

The goal of the SGP-BACIP collaboration was to introduce specific, energy-efficient products into communities in the Nathiagali and Gilgit areas of northern Pakistan. By installing demonstration models and training local entrepreneurs to produce these products, BACIP seeks to initiate wide replication of these products in a self-sustaining manner. In particular, BACIP does not subsidize the cost of any of its products, and instead seeks to integrate these products into local economies and develop credit mechanisms to help users overcome initial purchase costs.

### Implementation

The BACIP Program of the Aga Khan Foundation has conducted extensive research and developed about 60 techniques for reducing energy use in cooking and heating homes. This research has been carried out with community participation in order to come up with usable techniques and solutions; some products have gone through as many as 7 variations between the first and final prototypes.Training modules and construction manuals have been developed for each product or technique.

The SGP grant mainly supports the dissemination of three specific products: the roof-hatch window (RHW), fuel-efficient stoves (FEW) and a water-warming facility (WWF), which is connected to the stove. In addition,the project promotes thermal wall insulation, roof and floor treatment for thermal efficiency and also timber free house construction techniques for rural houses. To disseminate products in a village, BACIP staff work with existing village institutions, including women's organizations. Two resource persons from the village are nominated to coordinate project activities there. Then, BACIP identifies a few households in which to install models of these products; only these models are fully paid for by BACIP.These households are selected for their ability to promote the products. BACIP also helps organize complementary awareness-raising activities, including a road show of various building techniques. At the same time, local entrepreneurs are trained in how to produce these products, and in basic business management. BACIP works with these entrepreneurs in supplying needed materials and ensuring product quality.

BACIP also works with other development agencies, some of which are also active in the Gilgit and Nathiagali areas. One challenge facing BACIP is the fact that other agencies introducing the products are providing subsidies, while BACIP itself has decided against this approach. This may be slowing the dissemination of products by BACIP; some community members have reportedly held off on purchasing a product in the hope of obtaining it for less elsewhere. Nonetheless, together, all the agencies' efforts, including those of SGP-funded BACIP, have resulted in 819 BACIP products installed or replicated in the project area, and over 2,500 products manufactured or sold by entrepreneurs both inside and outside the project area.

### Technology

The technologies supported by the SGP project include:

- Fuel efficient stoves (FEW), which include a water-warming facility (WWF) that can be used while cooking (reduces 50% energy needs)
- Roof hatch windows (RHW), which allow more sunlight in the home but reduce heat loss
- Light roofs and efficient construction techniques which use 60% less timber in construction, and due to their thermal efficiency reduce up to 65% firewood needed to heat homes in the winter. These techniques also help reduce hazard risks during earthquakes.
- Insulation and other thermally-efficient housing construction techniques which reduce energy use by up to 70%
- Roof treatment techniques and the introduction of stabilized mud blocks to improve the thermal efficiency of houses in rural mountain environments

Technical descriptions of three techniques – the wire-mesh knotting equipment, galvanized wire-mesh wall reinforcement, and the house planning tool – are available at the following website: http://www.icimod.org.np/focus/risks_hazards/bacip1.htm

### Environmental Benefits

*Global:* The reduced use of biomass energy decreases carbon dioxide emissions that contribute to climate change. The project evaluation estimates that the use of fuel-efficient stoves with water-warming facilities in 2,500 households (the current estimate of project impact), would reduce fuel wood consumption by 862,500 kg per month. This is equivalent to 10 tons of fuel wood per year, and 30 tons of carbon emissions avoided over a six-year product life.

*Local:* Although no studies of this impact are available, the reduced collection of fuel wood and other biomass should lessen pressure on local forest ecosystems.

### Local Livelihood Benefits

*Health:* Reduced use of biomass in the home for cooking and heating improves air quality and lessens the risk of eye and respiratory problems, especially for women and children. Homes are warmer in the winter and overall have better temperature control. The BACIP project evaluation indicates a 50% reduction in illnesses (a 4.3% illness rate in homes with BACIP interventions compared to a 9% illness rate in non-BACIP households).

*Reduced drudgery:* Women and childrens' workloads are lessened by reducing the amount of firewood that must be collected for cooking and heating.

*Income generation:* The project has increased employment opportunities in the construction sector. Some entrepreneurs have been able to start their own businesses selling BACIP products; for some, selling BACIP stoves is their sole source of income.

*Increased savings:* In Gilgit, 42% of the people buy firewood, and 58% collect it for free. Those who purchase wood and now use the fuel-efficient stove and water warmer save about $0.70 per day on firewood (1 kg costs approximately $0.06). In Nathiagali, wood is about half the price and only 20% of households purchase it, so savings are lower.

### Capacity Development

Since the project trains local artisans, the major emphasis of the project is on capacity building. Technical training components are highly developed due to BACIP's detailed training modules and instruction manuals for each product or technique. Entrepreneurs are also trained in basic business management, although this training appears to be less detailed. Many entrepreneurs already have their own businesses, and are simply integrating BACIP products into their work.

### Partners

The Aga Khan Housing Board in Pakistan, which has implemented the project, is partnering with SGP in its efforts to initiate and spread the use of these innovations. BACIP also works with other development agencies in this area, including the World Wide Fund for Nature-Pakistan (WWF-P) and the Natural Resource Conservation Project. It appears that coordination of efforts is fairly good, except in the approach to subsidies. BACIP does not provide them, while the others do, which may undercut somewhat BACIP's efforts to create markets for these interventions. A key partner for the future will be the First Micro Finance Bank (FMFB), which with BACIP is planning a credit scheme to enable households to purchase equipment upfront and pay back loans over time using savings in fuel costs.

## LESSONS LEARNED

### Environmental Management

The project takes a comprehensive approach to integrating natural resource management with the built environment in this remote region. While introducing renewable energy technologies would also reduce carbon dioxide emissions and alleviate reliance on traditional biomass energy sources, the energy efficiency interventions promoted through this project may indeed have an equal or even greater impact on carbon dioxide emissions and livelihood improvements. One advantage this project has is that it uses local materials and relies on local artisans who are already involved in housing construction; therefore, they may be able to easily integrate these techniques into their work. This is in contrast to some renewable energy projects, which require the introduction of completely new technologies for which technicians must be trained from scratch and spare parts must somehow be obtained. An efficiency approach using existing energy sources may be just as valuable as introducing renewable energy technologies. Greater study may be necessary as to the conditions under which one may be preferable over the other.

### Barrier Removal

*Technical:* BACIP has documented its research very well, and

developed significant written materials that describe its products,their construction and installation.The BACIP-SGP collaboration reduces technical barriers to energy efficient housing and cooking products by training entrepreneurs to produce them. One key to success appears to be a willingness to adapt and re-adapt the products, tailoring them to each setting. For example, through this project it became apparent that the stove model used in Gilgit did not work well at all in Nathiagali, which is a more remote and colder region.In fact,introduction of the Gilgit model there actually resulted in increased fuel wood use. BACIP had to work with local Nathiagali entrepreneurs and households to specially adapt the stove to local conditions;the new model introduced in November 2002 appears to work much better.

*Institutional:* Institutional barriers are being addressed,since the program does involve local village structures and organizations in disseminating the products. However, BACIP is still working to establish the institutions necessary for a flexible, decentralized market-based mechanism for product dissemination. Currently, BACIP is quite centralized in how it handles supply procurement, manufacturing and promotion. Trading networks need to be established to ensure that local entrepreneurs can access the supplies they need; BACIP plans to establish regional centers to work with local entrepreneurs in marketing and distribution. BACIP intends its role to evolve into that of a facilitator, with its primary concern being the maintenance of product quality. In many ways, BACIP's approach is similar to that of ADESOL in the Dominican Republic, an SGP-supported project that has built a network of small enterprises that sell solar panels. Based on ADESOL's experience, developing a decentralized network of small enterprises can be very effective (ADESOL has reached over 5,000 households), but ADESOL still plays a critical role in assuring product quality and conducting random accounting audits.

*Financial:* The project does not provide funding to residents to finance the implementation of these new techniques.Residents must make these improvements themselves, using their own finances and labor. Some products require a coordinated purchase involving a number of potential users, and in these cases local NGOs are helping facilitate this. BACIP is also developing a new partnership with a micro-finance institution, which will help overcome financial barriers as well.Again,the comparison with ADESOL in the Dominican Republic is interesting.Instead of developing a relationship with a separate micro-finance institution, ADESOL established its own revolving loan fund to which all of its enterprises have access.

## Scaling Up

Ensuring the widespread use of these efficient cooking and housing innovations is the ultimate goal of this project. So far, the producers have already been trained in constructing new materials, and they are beginning to integrate these new products into their regular production patterns. Demand for these products and services is expected to increase as a result of the awareness-raising efforts undertaken by BACIP. The project evaluation recommends that BACIP focus more on particular products rather than pursuing many different products and techniques at the same time. BACIP has developed a 5-year marketing plan, and it will take some more time to determine the degree to which success has been achieved.

## SOURCES CONSULTED

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