PD-ACH-774

PA Consulting Group

US Agency for International Development

Energy Efficiency Demonstration Projects Final Report

Contract No. LAG-I-00-98-00005-00; Task Order 15

December 31, 2000

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We are proud that our clients say ***"PA makes it happen".***

PA

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Version: 1.0

US Agency for International Development

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1. EXECUTIVE SUMMARY

PA Government Services, Inc. (hereafter PA or PA Consulting) was requested by the U.S. Agency for International Development to design and complete a minimum of 42 energy efficiency demonstration projects throughout Georgia from September 1999 through year-end 2000. The projects were classified as governmental (12), residential (12), commercial (12), industrial (2), vulnerable population (2), vulnerable municipality (1), and fuel conversion (1). In addition, two extra governmental projects were accomplished within the task order budget, for a total of 44 demonstration projects.

The goals of the program were to build up Georgian businesses in the energy service sector; to train Georgians in energy efficiency; and to show Georgians how to conserve energy cost effectively. These goals were met. The approach was to employ Georgians to do the analysis, design, procurement and construction of the projects. Georgian businesses were stimulated by the award of one half million dollars of demonstration contracts and encouraging them to market their new skills in energy efficiency. Georgian engineers were taught to find savings and perform as consultants by managing projects for a fee. Training was accomplished by requiring program participants to become Certified Energy Managers and to take additional courses in weatherization techniques and business practice. Approximately two dozen contractors and two dozen consultants were trained in this manner. Energy conservation and cost effectiveness of the projects are summarized by category in the following table.

PROJECT CATEGORY	ESTIMATED SITE ENERGY SAVINGS (MWh/yr)	COST SAVINGS (1000 USD/yr)	TOTAL COST (1000 USD)	SIMPLE PAYBACK (yr)	SIR	EMISSIONS REDUCTION		
						CO_2 (Mg/yr)	SO_x (kg/yr)	NO_x (kg/yr)
Governmental (13)	1514	63.7	200	3.1	1.3	957	1159	3494
Governmental (SOGA)	51	0.9	57	64.3	0.1	12	0	9
Residential (12)	1041	34.9	107	3.1	1.3	534	600	2098
Commercial (12)	586	22.8	99	4.3	0.9	522	716	1535
Industrial (2)	1827	16.7	34	2.0	2.0	960	1227	1186
Vulnerable Population (2)	269	7.5	13	1.8	2.2	127	159	212
Vulnerable Municipality (1)	72	2.5	12	4.8	0.8	79	102	135
Fuel Conversion (1)	244	15.4	65	3.7	1.1	229	355	896

A key feature of the program was its emphasis on energy economics. Participants learned to evaluate the feasibility of each measure in terms of its life-cycle cost, using a discount rate and the present value of money.

Additional benefits of the program were cooperation with other donor agencies, such as KFW of Germany, and the strict use of products readily available in the Georgian markets.

2. OBJECTIVES

In order to demonstrate the benefits of energy efficiency to Georgia and to begin developing an energy service industry, PA Consulting was tasked with developing and implementing a minimum of 42 energy efficiency demonstration projects. The projects were to be divided as follows: governmental (12), residential (12), commercial (12), industrial (2), vulnerable population (2), vulnerable municipality (1), and fuel conversion (1). The projects were to be distributed equitably among Georgia's geographic regions. One project was to be conducted among customers of the Rustavi billings and collections pilot program to provide more accurate measurement of project effects.

The projects were to be implemented by employing local Georgian subcontractors and labor. PA Consulting was to provide training as needed in contracting bidding and installation skills to qualify the contractors and local labor to perform the work. Training was to be accomplished through conducting a minimum of two seminars.

All materials and equipment in the program were to be purchased from Georgian or NIS sources where possible and cost-effective. This helps satisfy the goal of developing Georgian energy service companies (ESCOs) and local manufacturing sources to supply the materials and perform the work. Implementation of the program required specific work activities to foster and support the development of these local industries.

Two of the projects were to be at residential sites with customers having bill payment problems that caused them to be threatened with service termination. One project was to be implemented for a municipal customer experiencing similar bill payment problems.

3. APPROACH

3.1 PROJECT IDENTIFICATION AND SELECTION

3.1.1 Sites

PA Consulting began the process of choosing projects by contacting municipal officials in key cities, distributed equitably among Georgia's geographic regions: Tbilisi, Mtskheta, Rustavi, Bolnisi, Dusheti, Gori, Kutaisi and Batumi. Most projects were identified by following leads from municipal authorities. Fourteen projects were developed and implemented with governmental customers, 12 with residential customers, 12 with commercial customers, two with industrial customers, two among vulnerable populations, one with a vulnerable municipality, and one specifically to demonstrate fuel conversion in an apartment building. The fuel conversion project was conducted in Rustavi where remetering had taken place, in order to provide a more accurate measurement of project effects.

Sites to assist vulnerable populations (i.e., those with bill payment problems that threaten disconnection) were chosen in Gori and Rustavi. The project to assist a vulnerable municipality was sited in a district of Kutaisi.

Selected project recipients signed a statement accepting their projects and promising to allow demonstrations of the sites. Wherever possible, PA Consulting chose projects for recipients who showed a good payment history on their utility bills. Recipients produced a baseline of one year's energy consumption records for the project engineers to analyze. The engineers, working in the capacity of assistant project managers (APMs), did a preliminary analysis to define potentially feasible measures at each site.

3.1.2 Contractors

Next the APMs wrote a request for proposals (RFP) for each project. PA Consulting gave each RFP to three or more qualified contractors for bidding. Contractors were sought through announcements in the newspaper, in a trade association, and by word of mouth. Contractor qualifications included an established reputation for doing the type of business required and sending one or more company representatives through PA's training program. Required training consisted of courses in business practice, weatherization and passing the Certified Energy Manager (CEM) examination.

After receiving proposals from contractors, the PA team evaluated each one according to a uniform set of criteria. In order to avoid receiving low quality work from the lowest bidders, 60% of the evaluations were based on the bidders' technical understanding, proposed methodology, and quality. Price quotations only comprised 40% of the weighting. In the end, every contractor trained and qualified by PA Consulting won at least one award.

3.1.3 Measures

Primary emphasis was on weatherization. Every single project, except for the two industrial projects, received weatherization of windows and doors to stop heat losses. Some sites received attic insulation, some had other repairs to their building envelopes, and one had floor insulation added. Sites with central heat had their water pipes and tanks insulated. In

the same spirit of heat retention, the two industrial projects consisted primarily of insulation of pipes and tanks.

Weatherization was so important that PA Consulting commissioned the writing of a weatherization manual by an energy efficiency expert with a long history of USAID weatherization projects in the Caucasus. Techniques described in the manual include the removal of windows from frames and glass from windows, complete repair of all damaged and worn parts, hermetic sealing of every type of gap, reassembly, refinishing, extra insulation behind radiators, attic insulation, and ventilation for safety. The manual was part of every RFP package and contractors were held to the standards published in the manual.

Other common measures treated lighting and heating systems. One project treated domestic hot water (DHW), and another treated a drinking water storage pump.

Occupant input was seriously considered during the selection of measures. Those who live and work in a facility usually have a good understanding of its needs. The PA team of energy analysts chose energy conservation measures (ECMs) that satisfied the overlapping interests of occupants' needs and program goals. Examples are: a) replacing boiler burners to switch fuel; and, b) replacing central diesel boilers with vented room heaters that operate on free sawdust. The latter is an example of switching from a fossil fuel to a renewable fuel. The projects demonstrated that when occupants believe in a technology, they will strive to make it work.

3.2 FEASIBILITY ANALYSIS

3.2.1 Methodology

PA Consulting provided the APMs with a sample audit report, tailored for the large fuel conversion project in Rustavi. The sample called for:

a) definition and separation of energy conservation measures (ECMs)

b) organization of input data and assumptions

c) calculation of potential energy savings at both site and source

d) calculation of potential cost savings

e) calculation of associated emissions reductions

f) calculation of simple payback

g) life-cycle cost analysis producing a savings-to-investment ratio (SIR).

APMs produced reports organized with:

a) an executive summary with table, recommendations and discussion

b) an input page with technical and financial data

c) technical calculations for energy and emissions

d) financial calculations.

3.2.2 Life-Cycle Costing

Life-cycle cost analysis was an important lesson taught to program participants. Most had never seen nor heard of it. To keep the introduction simple, the procedure was reduced to ten steps to determine feasibility. Participants were generally pleased to learn about the technique.

Every measure in every project was subjected to a life-cycle cost analysis. All costs and savings were calculated at present value using a 20% discount rate. This is an intermediate rate for a high-risk economy like Georgia's. The rate is lower than commercial bank interest, but higher than development bank lending rates.

Two major advantages of the life-cycle test are that:

a) It predicts how much investment is too much. Simple payback does not show the limit of feasibility.

b) It accounts for future investments (periodic rebuilds and other non-annual expenses).

All measures were analyzed on a 10 year life-cycle for equal comparison. Measures with a shorter natural service life were budgeted for rebuilding as necessary to extend them to the common analysis period of 10 years.

The standard measure of feasibility used throughout the program is the savings-to-investment ratio (SIR). It is the ratio of life-cycle discounted savings to life-cycle discounted investments. For the given discount rate, measures and projects with an SIR greater than 1.0 earn more returns than they cost. SIRs less than 1.0 identify financially unfeasible measures and projects in terms of the energy savings they provide. This is the method used by the US Federal Government in its own facilities.

3.2.3 Savings vs. Comfort

Direct benefits of heating measures (weatherization, boilers, thermostats, etc.) include a combination of cost savings and improved comfort. A common misconception is that projects can produce full savings plus full comfort. In reality it is a trade-off.

For consistency and clarity, analyses of all heating measures in this program held comfort constant before and after improvements. In other words, even if the actual baseline temperatures were substandard, analysts calculated fuel savings at the same actual temperatures and thus determined project feasibility. This method considers strictly the realities encountered by the analyst. Occupants later have the option of purchasing more fuel to increase comfort at the expense of savings.

3.2.4 Cascading Measures

Some projects included improvement of heating systems in addition to weatherization. To avoid double counting of savings, weatherization savings were calculated first. Then heating baselines were reduced by an amount due to weatherization before calculating savings for heating systems.

3.2.5 Externalities

Every measure in every project had its emissions reductions calculated. No monetary value was assigned to these reductions, but the information is nonetheless useful for evaluation purposes. To do so begins to recognize the environmental impact of energy efficiency.

A special analysis tool called the Georgia Fuel Data table was created for this program. Among other items, this table gives information specific to Georgia, which was used as input to the emissions calculation spreadsheets. Georgia has a heavy hydroelectric generation component, which is seasonal. Therefore, the generation mix used in winter electric heating is very different from the annual average applied to lights and motors. PA analysts accounted for this variation and allocated the appropriate emission levels to each measure, on a case-by-case basis.

3.3 IMPLEMENTATION

3.3.1 Project Boundaries

In this program, exterior doors and windows were defined as those that separate heated areas from non-heated areas. In many cases, corridors and selected rooms of buildings are intentionally not heated, so their interior doors were weatherized as exterior doors.

Other major breaks in the integrity of project boundaries were also treated as needed. For example, after doors and windows had been weatherized at the theater in Mtskheta, a five square meter hole in the ceiling was identified that the contractor repaired at his own expense.

3.3.2 Repairs

Due to a mid-year increase in the program budget, it became possible to add roof repairs to 13 more of the projects. Although roof repairs produce no direct savings, they create proper conditions for all energy efficiency measures to succeed. In sites with sloped roofs, repairs created dry attics thus permitting the addition of attic insulation for further savings and comfort.

3.3.3 Local Procurement

PA Consulting avoided special order of imported products for use in the implementation of virtually all of the projects. Whether domestic or imported, all equipment and materials were easily available on Georgian markets. Therefore, the high cost, long lead times and problems associated with importation were not barriers to completion of projects. The only exception was the heat cost allocators (HCAs) in the fuel conversion project in Rustavi. They are only manufactured outside of Georgia and their import was straightforward.

During the course of developing the projects, the PA team discovered that Gasmsheny, a Georgian company, was selling locally manufactured gas heaters. These heaters were compact, vented, inexpensive, and came with thermostats. They were exactly what many of the projects needed to improve heating efficiency cost effectively. The USAID program exhausted the vendor's supply and back ordered many more. All orders were filled by year-end 2000. These projects will be serve as a useful demonstration of a Georgian made product.

3.3.4 Self-Determination

In the fuel conversion project in Rustavi, residents of the high rise apartment building received a new heating system with a single boiler, but no future financial support. They need to pay for future fuel, operation and maintenance themselves and thus, they will have to cooperate with each other to work out payment arrangements.

A loose-knit homeowners' association with elected leaders already existed in the newly privatized building. PA met with the residents several times and explained their payment options. At this site USAID provided heat cost allocators (HCAs) on every radiator as instruments to assist in improving the allocation of payment, but the ongoing operation of the system will be the group's responsibility. Residents seemed determined to make it succeed.

3.4 PROFESSIONAL TRAINING

3.4.1 Georgia Association of Energy Engineers (GAEE)

Throughout the course of the program, the Georgia Association of Energy Engineers was a valuable resource. GAEE is a chapter of the Association of Energy Engineers (AEE), a US based non-governmental organization (NGO). The training and certification program leading to the professional credential of Certified Energy Manager (CEM) is American in origin. GAEE is authorized and franchised to teach the course, administer the exam, and grant certificates. PA Consulting contracted GAEE to conduct this activity independently. Four CEM classes were graduated.

The contract with GAEE also tasked the association with recruiting candidates for program participation and hiring them as APMs after completing all training requirements. APMs' duties included preliminary project analysis, writing RFPs, bid evaluation, contractor oversight, work inspections and final analysis.

3.4.2 Georgia Greens

PA also retained the Georgia Greens to assist in the weatherization aspect of the program. Due to their extensive experience in Georgia, the Greens were contracted to teach a weatherization course with material provided by PA and to inspect contractors' work. The course included both textbook and hands-on instruction as a requirement for all contractors doing projects involving weatherization. The performance of the Greens representative assigned to this work was excellent. In total, four weatherization classes were conducted.

3.4.3 PA Training

PA Consulting conducted further training in the area of business practices. Building on experiences with energy efficiency projects in other NIS countries, PA instructors emphasized the need for open, transparent business transactions. Contractors learned about client expectations in the areas of proposals, competition, negotiation, contracts, workmanship and ethics. Four such seminars were conducted.

One of the best results of the program in terms of professional development is that contractors, without exception, performed all work as promised within the agreed price. The business training courses emphasized that PA expected contractors to solve problems that arose in the course of work at their own expense, without argument; this was in fact the case.

Not once did a contractor request additional funding after contract award, a practice frequently encountered in previous projects in other countries.

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4. OVERVIEW

This chapter provides a brief description of each of the demonstration projects organized according by customer category.

4.1 GOVERNMENTAL PROJECTS

G-1 Orphanage, Tskneti

This orphanage consists of an administration building and three residential buildings. On the three residential buildings, the USAID project: a) weatherized exterior doors and windows; b) insulated the attics, c) replaced incandescent lights with compact fluorescent lamps (CFLs), and d) repaired the roofs. The boilers serving all four buildings were converted from oil fired to gas fired. Finally, thermostatic regulating valves (TRVs) and bypass pipes were added to all radiators in one residential building.

Apart from the State Oil & Gas Agency (SOGA) project, the Tskneti orphanage had the greatest investment of all governmental projects. TRVs were considered for the other two residential buildings, but their heating distribution systems had not been properly maintained for years. The addition of TRVs would have required a further, extraordinary expense to overcome deferred maintenance.

G-2 Orphanage, Tbilisi

Domestic hot water (DHW) is the unique feature of this project. In this orphanage, the contractor installed a DHW distribution system that takes heat, thermostatically controlled, from the boiler, so the institution does not need to use electric water heaters. This winter, the new system will not be used yet because the orphanage is a recipient of free electricity under USAID's Winter Heating Assistance Program. Benefits from the DHW measure will begin next year.

This site also received weatherization of exterior doors and windows, and CFLs to replace incandescent lights.

G-3 Orphanage, Khelvachauri Region

Renewable energy in the form of free biomass is the highlight of this project. At the suggestion of the orphanage director, USAID had 10 sawdust heaters installed. The director was comfortable with the operation and maintenance of sawdust heaters, since she uses one in her own home.

The use of sawdust as fuel, although somewhat unusual, has multiple economic and environmental benefits in this situation:

a) The net emissions of carbon dioxide (a greenhouse gas) are near zero because trees absorb as much CO_2 during growth as they emit after life;

b) Consuming sawdust prevents dumping it into streams and fields where its acid content kills fish and plants;

c) It is free. The only expense to the orphanage is delivery by truck from nearby sawmills. Through this project, a waste product is being converted into energy.

Other measures installed in this project include weatherization of exterior doors and windows, replacement of incandescent lights with CFLs., and roof repairs.

G-4 Nursing Home, Kheivachauri Region

This site near Batumi has an extensive surface of exterior windows and doors. The exterior walls of all occupant rooms are nearly all glass. Winter heat losses were tremendous, and senior citizens were very uncomfortable. The primary measure of weatherization was more urgent here than in most buildings.

The institution also received CFLs to reduce electricity consumption. Natural gas is not available in the region for heating improvements.

G-5 Hospital, Batumi

Gas is not available in Batumi, so this hospital uses diesel fuel in the boiler that heats the maternity wing. One unique feature of the USAID project here was the boiler treatment. The contractor replaced the old boiler's burner with an efficient new burner and added a smaller, second boiler for better control, efficiency and capacity.

A second unique measure was pump replacement. It is a small, but useful demonstration. The Russian water pump that the hospital used to charge its water tower was severely out of balance and audible from 100 meters. It had to be replaced three or four times a year. The contractor replaced it with a western European pump, available locally, that runs on much less power. It is quiet and should last for many years.

The maternity wing of the hospital also received weatherization, TRVs on the radiators, CFLs, roof repair and attic insulation.

G-6 School #1, Bolnisi

This project consisted of one large measure, that being the weatherization of the old wing of a large school.

G-7 School #56, Tbilisi

A major accomplishment of this project was getting permission from local authorities to use wall-mounted, vented, natural gas heaters. Safety regulations in Georgia are subject to wide interpretation by local inspectors. Originally, the project design considered acceptable by the inspector was cost

prohibitive. However, he later accepted our redesign that featured the innovation of low cost, locally manufactured gas heaters from Gasmsheny. The resulting installation was very well received by the beneficiary.

Other measures implemented at School #56 included weatherization, CFLs, roof repair and attic insulation. The school received the additional benefit of partial weatherization beyond the contractor's scope of work because hands-on weatherization training took place at this location.

G-8 Kindergarten, Bolnisi

This school received weatherization, CFLs, a new boiler to replace its defunct boiler, TRVs, and complete rehabilitation of the heating distribution system. The building was in need of other repairs. The roof leaked badly, and the floor was dangerous to walk on. However, another group of donor organizations, led by the World Bank, had immediate plans to renovate the structure with measures that complemented USAID's.

G-9 Kindergarten, Gori

The budget allowed treatment in two out of three buildings in this complex. Measures included weatherization, gas heaters with thermostats, roof repair and attic insulation.

G-10 Hospital, Gori

The third floor of a hospital in Gori received the full treatment, including weatherization, lighting, a new boiler, TRVs and rehabilitation of the hydronic heating system with modern convectors (thin radiators). Treatment of top floors in multi-storey buildings automatically keeps lower floors warmer, an unquantified benefit of the USAID project.

G-11 Otskheli School #2, Kutaisi

Otskheli School #2 is a very old, historic building with a proud tradition. It has solid construction and may last into the next century. The USAID investment here in weatherization and lighting improvements will set an attractive example for others.

G-12 Armenian School, Bolnisi

Like many institutions in this program, the Armenian school chosen for treatment in Bolnisi is very poor. Pupils study in stark conditions with meager resources. The complete replacement (not repair) of windows and doors, the roof repairs, and the attic insulation will go a long way to improve the learning environment for the children of one of Georgia's ethnic minorities.

G-13 Middle School, Zvari

In the most remote location of this year's program, the USAID energy efficiency upgrade was coordinated with the roofing repairs done by KFW, the German development bank. The two contractors overcame all scheduling difficulties and completed work on time. PA subcontractors did weatherization and attic insulation.

G-14 State Oil & Gas Agency (SOGA)

This project employed the most extensive and advanced energy efficiency technologies. To heat a renovated gymnasium to be converted to office space without stratification, PA Consulting chose radiant, hydronic floor heating with zoned controls instead of lower cost conventional options. To demonstrate the best insulation practice, the specifications called for complete wall insulation, not just at hot spots. Other energy efficiency measures included new, double pane, plastic framed windows; new, insulated steel doors, efficient lights; and attic insulation. The roof was also replaced.

This project began with a non-functional site in very poor condition. No heat, light or insulation was in working order anywhere. The site also needed major non-energy repairs, done by a separate contractor. The goal was not to produce the most cost effective project, but to produce an energy efficient office space environment.

4.2 RESIDENTIAL PROJECTS

R-1 High Rise Apartments, Jinvali

This project treated a section served by one stairwell of an eight storey apartment building in Jinvali. It received weatherization and roofing repairs.

R-2 Two Storey Apartments, Bolnisi (185 Orbeliani St.)

This was a project to simply demonstrate the benefits of weatherization in a small residential building. It is located in the center of Bolnisi, near city hall, for high visibility.

R-3 Two Storey Apartments, Bolnisi (104 Orbeliani St.)

At the suggestion of city officials, this second small residential building was weatherized in the downtown portion of Bolnisi.

R-4 Two Storey Apartments, Batumi

This small residence received weatherization, lighting replacement and ceiling repair. It will show residents of similar buildings in the west the benefits of energy efficiency.

R-5 Apartments, Gori

This site is actually one apartment shared by three families. It has a common kitchen and bathroom. The small building was weatherized and its roof was repaired.

R-6 Two Storey Apartments, Kutaisi

An apartment in a two storey building was chosen as the residential example in the city of Kutaisi. It received weatherization, lights and roof repair.

R-7 High Rise Apartments, Dusheti

As an example of improving a large residential building, this site was chosen in Dusheti. One stairwell received weatherization and roof repair.

R-8 Two Storey Apartments, Dusheti

This project demonstrates energy efficiency in small residential buildings for the city of Dusheti. The apartments were weatherized.

R-9 Four Storey Apartments, Mtskheta

As a home for blind residents, this site was chosen to receive weatherization, lighting and roof repairs.

R-10 High Rise Apartments, Batumi

To demonstrate energy efficiency in a large apartment building in the west of Georgia, this building received weatherization and lighting improvements in apartments served by one stairwell.

R-11 Single Apartment, Tbilisi

This small apartment in Tbilisi was the only private residence to receive new heaters. It previously relied on electric heat. The weatherization prevented the loss of existing heat, and the gas heaters provided a new, clean source of heat. Lights were also replaced here.

R-12 Orphanage/Monastery

Because this institution belongs to the church, not the state, it is classified in the residential category. It is technically special in that the building was severely damaged by an earthquake years ago. To begin the project, a licensed structural engineer was brought in to inspect the structure and certify in writing that it was safe for contractors to work.

After receiving the safety certification, the contractor extended a nearby gas supply line to the building and provided gas heaters to selected rooms. The building was treated selectively to avoid the most severely damaged areas,

and to do the most good by weatherizing and heating the sleeping quarters. The facility also received some efficient lights.

4.3 COMMERCIAL PROJECTS

C-1 Store, Bolnisi (Kostava St.)

This project was in a grocery store on the main street in Bolnisi. It received weatherization and lighting.

C-2 Store, Tbilisi (81 V. Pshavela Ave.)

This site is a grocery store located in a neighborhood of small groceries and tailor shops. The measures implemented here can be well replicated by neighboring shops. This site received weatherization, lighting and a new gas heater to switch fuel from electricity to natural gas. A new gas meter was installed, also, for proper metering of gas consumption.

C-3 Restaurant Canteen, Jinvali

This is a unique site because the flat roof was insulated, usually not done due to its difficulty. Also, this small restaurant received weatherization, lighting and heating improvement by switching heating fuels from electricity to natural gas. The contractor provided natural gas to the site, then installed a gas meter and gas heaters.

C-4 Store, Gori

The uniqueness of this site is that together with weatherization and lighting, the grocery store received thermal insulation of its walk-in refrigerators in the storage part of the building.

C-5 Engineering Institute, Kutaisi

This educational facility is located on the top floor of a five storey building. Weatherization and lighting measures were accompanied by roof repairs.

C-6 Restaurant Aragvi, Dusheti

This large restaurant was selected at the recommendation of the local regional administration. The site received weatherization, lighting and wall-mounted, direct-fired, gas heaters. A new gas pipeline and gas meter were provided to the site.

C-7 Theater, Mtskheta

This is a large theater for public performances with a very high ceiling. All of its functional rooms and halls received weatherization and lighting improvements.

C-8 Store, Tbilisi (3 V. Pshavela Ave.)

This site is a tailor shop located in the same neighborhood of shops with project C2, the grocery store. The project included weatherization, lighting and fuel switching from electricity to natural gas. The site was supplied with natural gas before the project, but it had not been metered. A new gas meter was installed.

Having two converted sites in the same neighborhood of small businesses may serve as an incentive to other business owners to replicate the energy efficiency measures.

C-9 Store, Batumi

This site is a typical grocery store. It received weatherization and lighting. A unique detail of this project is that the glass windows of a refrigerated display case were repaired and sealed around the edges.

C-10 Film Shop, Rustavi

This site is co-located with the main fuel conversion project and another commercial project in the ground floor of an eight storey apartment building in Rustavi. Three different types of gas heating systems to replace kerosene and electric heat are demonstrated in the same building. The film shop has Gasmsheny wall-mounted heaters. The project is also in the USAID remetering pilot project area.

The building as a whole can be considered to be a complex demonstration of energy efficiency measures in the residential and commercial sectors. In addition to heating, the film shop received weatherization, a lighting upgrade, and its own gas meter.

C-11 Clinic, Rustavi

This site is also co-located with the main fuel conversion project and another commercial project in the ground floor of an eight storey apartment building in Rustavi. Three different types of gas heating systems to replace kerosene and electric heat are demonstrated in the same building. The clinic has a wall-mounted central boiler. It is a water heater normally used for DHW, but powerful enough to provide space heating to the entire weatherized business. Convector type radiators were installed to increase savings and the level of comfort for staff and visitors. The project is also in the USAID remetering pilot project area.

The building as a whole is considered as a complex demonstration of energy efficiency measures in the residential and commercial sectors. In addition to heating, the clinic received weatherization, a lighting upgrade, and its own gas meter.

C-12 School #1 (private), Kutaisi

This is a private secondary school located in a very old building. The site received weatherization and lighting.

4.4 INDUSTRIAL PROJECTS

Two industrial projects were completed.

I-1 Kazbegi Brewery, Rustavi

The brewery received:

a) insulation of a deaerator and steam supply pipeline

b) replacement and insulation of a steam condensate return line

c) a heat recovery heat exchanger. The recovered heat was used for DHW.

I-2 Azoti Chemical Plant, Rustavi

This industrial complex received two different improvements to its heat supply. The larger was the insulation of a 1.5 km steam pipe between the central boiler plant and one end-user station. The old insulation had deteriorated so badly that on rainy days the end user could receive no steam. The rain on the pipe condensed it all. Now the supply line is in reliable working order.

As a small demonstration, the second measure repaired the rust holes and insulated one of four flue gas ducts from the boilers to the stacks. The point was not to conserve heat in exhaust, but to:

a) prevent corrosion of the duct from premature condensation of acidic flue gases, and

b) reduce the load on the flue gas blower by plugging air leaks.

4.5 VULNERABLE POPULATION PROJECTS

VP-1 Refugee Apartments, Gori

The site is located on the top floor of both wings of the same building. This site is occupied by refugees, which are considered as the most economically vulnerable segment of society. Weatherization and lighting measures were implemented at this site to improve the financial situation of the occupants and increase their level of comfort.

VP-2 Refugee Home, Rustavi

Initially a kindergarten, now serving as a home for refugees and a nursing home, this site received weatherization, lighting and natural gas heating to replace other mixed fuels. A natural gas supply was provided to the site. Wall-mounted, vented gas heaters were installed in the weatherized part of the building. The project budget could afford to upgrade only a part of the building. The site also received roof repair.

4.6 VULNERABLE MUNICIPALITY PROJECT

VM-1 Ukimerioni Municipal Building, Kutaisi

This is a one storey office building for the administration of one of the regions of Kutaisi. The site received weatherization, lighting and roof repair.

4.7 FUEL CONVERSION PROJECT

FC-1 Eight Storey Apartments, Rustavi

This large project fulfilled the objective of demonstrating the benefits of switching to natural gas in a large residential building. PA Consulting chose a 32-apartment high rise with a single stairwell in Rustavi.

This site is co-located with two smaller fuel conversion projects in the commercial category on the ground floor. Three different types of gas heating systems to replace kerosene and electric heat are demonstrated in the same building. The apartments have a modern, central, gas-fired boiler. The building's entire residential heating distribution system was rehabilitated. Thermostatic regulating valves (TRVs), bypass pipes and heat cost allocators (HCAs) were added to each of the 112 reconditioned radiators. The building received its own, new gas meter. Additionally, every apartment was weatherized and the flat roof was repaired.

The project is also in the USAID remetering pilot project area. The building as a whole is considered to be a complex demonstration of energy efficiency measures in the residential and commercial sectors.

During a follow-up visit, PA Consulting learned that gas pressure was not always sufficient, as the municipality had assured, to operate the new boiler. The private clinic in the same building had sufficient pressure from another line, but the boiler serving the 32 families was down. On the positive side, the weatherization in the apartments was so effective that dwellers felt warm enough on most days without the heating system. They felt no need to revert to their old kerosene and electric heaters.[1]

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[1] PA is working with the municipality to address the gas pressure issue.

5. COSTS AND BENEFITS

5.1 TECHNICAL

Measures used most widely in the energy efficiency program have the following technical benefits:

Weatherization:

- Reduction of all forms of heating energy with their associated costs and emissions.
- Improved comfort through stabilization and the ability to increase temperature.
- Structural and cosmetic repair of windows and doors as a by-product of the energy efficiency work.

Lighting:

- Reduction of electricity consumption with its associated costs and emissions.
- Increased lamp life by an order of magnitude.
- Possibly improved lighting levels.

Heating Systems:

- Reduction of all forms of heating energy with associated costs and emissions.
- Thermostatic control (in most heating systems) to relieve occupants of the constant need to adjust heating levels to meet changing conditions.
- Improved comfort through stabilization and the ability to increase temperature.

Roof Repairs:

- Protection of all other measures against rain damage.
- Protection of the building structure and appearance against rain damage.

The possibility of installing attic insulation (under sloped roofs) in a dry attic.

5.2 FINANCIAL

By category of project, the individual and total energy savings, cost savings, capital investment, simple payback, life-cycle savings-to-investment ratio (SIR), and emissions reductions are tabulated below. In general, projects burdened with the expense of roof repair have longer paybacks than those without.

Governmental Projects: As a category, the governmental projects appear to be generally cost-effective.

No.	SITE NAME	SITE ADDRESS	MEASURES	CONTRACTOR	APM	ESTIMATED SITE ENERGY SAVINGS (MWh/yr)	COST SAVINGS (USD/yr)	TOTAL COST (USD)	SIMPLE PAYBACK (yr)	SIR	EMISSIONS REDUCTION		
											CO_2 (Mg/yr)	SO_x (kg/yr)	NO_x (kg/yr)
G1	Orphanage	Tskneti, 5 Stalin St.	- Weatherization - Lighting - Fuel switching - Hydronic system - Attic insulation - Roof repair	Spetsmontaj-avtomatika	Tamaz Gigilashvili	74	5,138	25,661	5.0	0.9	183	163	199
G2	Orphanage	Tbilisi, 22 Grishashvili St.	- Lighting - Weatherization - DHW **	Techno Therm	Tamaz Gigilashvili	92	4,016	6,593	1.6	2.5	48	33	48
G3	Orphanage	Khelvachauri region	- Weatherization - Lighting - Sawdust stoves - Roof repair	Tori	Badri Beridze	96	3,213	16,162	5.0	0.8	55	64	140
G4	Nursing home	Khelvachauri region	- Weatherization - Lighting	Adjara 92	Sulkhan Kikava	129	5,339	8,372	1.6	2.5	112	134	192
G5	Hospital	Batumi	- Weatherization - Lighting - Boiler - TRVs - Pump - Roof repair	IQ	Sulkhan Kikava	128	13,795	24,166	1.8	2.3	151	145	168
G6	School #1	Bolnisi, 139 Orbeliani St.	- Weatherization	BB Ltd	Ilia Lashkhi	115	2,400	7,997	3.3	1.1	57	78	213
G7	School # 56	Tbilisi, Paliashvili St.	- Lighting - Weatherization - Gas heaters - Roof repair	Spetsmontaj-avtomatika	Demi Laoshvili	11	5,506	23,312	4.2	1.0	21	15	21
G8	Kindergarten	Bolnisi, 131 Ochkhikidze St.	- Weatherization - Lighting - Boiler - TRVs - Hydronic system	BB Ltd	George Gogshelidze	345	4,720	18,101	3.8	1.1	9	87	927
G9	Kindergarten	Gori	- Weatherization - Gas heaters - Roof repair	Dagi Ltd	Baadur Chkhaidze	94	2,936	10,503	3.6	1.1	26	26	601

Due to its unique nature, the State Oil & Gas Agency (SOGA) renovation is listed separately from other governmental projects. It was chosen by different criteria and is a demonstration of a comfortable and productive work environment, as opposed to humanitarian aid or cost effectiveness in terms of energy efficiency.

No.	SITE NAME	SITE ADDRESS	MEASURES	CONTRACTOR	APM	ESTIMATED SITE ENERGY SAVINGS (MWh/yr)	COST SAVINGS (USD/yr)	TOTAL COST (USD)	SIMPLE PAYBACK (yr)	SIR	EMISSIONS REDUCTION		
											CO_2 (Mg/yr)	SO_x (kg/yr)	NO_x (kg/yr)
G14	SOGA	Tbilisi, Kazbegi Av.	- Windows, doors - Lighting - Heating System	TEG	Onik Aloyan	51	883	56,762	64.3	0.1	12	0	9

Residential Projects In general, the residential category of projects seems just as profitable as the governmental. One project, the orphanage/monastery, stands out as disproportionately. This is because it receives large amounts of donated heating fuel, not considered as part of the organization's budget.

No.	SITE NAME	SITE ADDRESS	MEASURES	CONTRACTOR	APM	ESTIMATED SITE ENERGY SAVINGS (MWh/yr)	COST SAVINGS (USD/yr)	TOTAL COST (USD)	SIMPLE PAYBACK (yr)	SIR	EMISSIONS REDUCTION		
											CO_2 (Mg/yr)	SO_x (kg/yr)	NO_x (kg/yr)
R1	High rise apartment building	Jinvali	- Weatherization - Roofing	Techno Therm	Tengiz Jishkariani and Temuri Mikiashvili	162	3,106	12,145	3.9	0.9	57	75	285
R2	Two storey apartment building	Bolnisi, 185 Orbeliani St.	- Weatherization	Angelina	George Gogshelidze	77	1,200	4,574	3.8	1.0	3	9	143
R3	Two storey apartment building	Bolnisi, 104 Orbeliani St.	- Weatherization	BB Ltd	George Ramishvili	65	1,864	4,072	2.2	1.6	17	17	92
R4	Two storey apartment building	Batumi	- Weatherization - Lighting - Ceiling	Adjara 92	Badri Beridze	23	905	6,071	6.7	0.6	11	12	27
R5	Apartment building	Gori	- Weatherization	Unikum Ltd	Levan Bakhtadze	38	802	5,811	7.2	0.6	13	18	67
R6	Two storey apartment building	Kutaisi	- Weatherization - Lighting - Roof repair	Gasmsheni	Vakhtang Samkharadze	95	3,233	12,876	4.0	1.0	104	135	179
R7	High rise apartment building	Dusheti	- Weatherization - Roof repair	Sophmshen-komplex Ltd	Temur Mikiashvili	80	1,529	7,971	5.2	0.8	28	37	140
R8	Two storey apartment building	Dusheti	- Weatherization - Roof repair	New House	Tengiz Jishkariani	30	361	3,916	10.8	0.5	5	8	55
R9	4 storey apartment block	Mtskheta	- Weatherization - Lighting - Roofing	New House	Nugzar Kandelaki	94	3,295	12,437	3.8	1.0	103	8	178
R10	Apartment block	Batumi	- Weatherization - Lighting	IQ	Vakhtang Tsitsadze	178	7,137	15,205	2.1	1.9	106	118	234
R11	Apartment	Tbilisi, 38 Khoshtaria St.	- Weatherization - Lighting - Gas heaters	Unikum Ltd	Baadur Chkhaidze	7	1,132	3,098	2.7	1.5	22	30	28
R12	Orphanage / Monastery	Surami	- Weatherization - Lighting - Gas heaters	Unikum Ltd	Revaz Kandelaki	192	10,317	18,473	1.8	2.9	65	133	670
SUMMARY						**1,041**	**34,881**	**106,649**	**3.1**	**1.3**	**534**	**600**	**2,098**

Commercial Projects The overall predicted performance of this category is lower than expected because the two largest projects are not cost-effective when measured simply in terms of energy savings. The costs of the roof repairs are the reason for the lower rate of return on the most expensive commercial demonstrations in this category.

No.	SITE NAME	SITE ADDRESS	MEASURES	CONTRACTOR	APM	ESTIMATED SITE ENERGY SAVINGS (MWh/yr)	COST SAVINGS (USD/yr)	TOTAL COST (USD)	SIMPLE PAYBACK (yr)	SIR	EMISSIONS REDUCTION		
											CO_2 (Mg/yr)	SO_x (kg/yr)	NO_x (kg/yr)
C1	Store	Bolnisi, 18 Kostava St.	- Weatherization - Lighting	Saqsakhlmshen	George Ramishvili	50	1,249	3,838	3.1	1.2	24	31	81
C2	Store	Tbilisi, 81 V. Pshavela ave	- Weatherization - Lighting - Gas heater	Spetsavtoma-tika	Temur Mikiashvili	12	1,637	3,497	2.1	1.9	18	20	21
C3	Restaurant Canteen	Jinvali, Dusheti district	- Weatherization - Lighting - Gas heaters	Sophmshen-komplex Ltd	Tengiz Jishkariani	25	917	7,008	7.6	0.5	19	36	145
C4	Store	Gori, 9 Stalini St.	- Weatherization - Lighting	Dagi Ltd	Ilia Lashkhi	28	1,578	3,389	2.1	1.6	24	27	28
C5	Engineering Institute	Kutaisi	- Weatherization - Lighting - Roof repair	QUT	Beso Kupreishvili	115	3,917	20,476	5.2	0.8	125	162	216
C6	Restaurant Aragvi	Dusheti	- Weatherization - Lighting - Gas heaters	Sophmshen-komplex Ltd	Tengiz Jishkariani	65	2,752	9,184	3.3	1.2	30	77	557
C7	Theater	Mtskheta	- Weatherization - Lighting - Roof repair	New House	Nugzar Kandelaki	61	1,295	16,950	13.1	0.7	39	52	112
C8	Store	Tbilisi, 3 V. Pshavela ave	- Weatherization - Lighting - Gas heater	Spetsavtoma-tika	Demi Laoshvili	12	1,526	4,221	2.8	1.5	11	10	12
C9	Store	Batumi	- Weatherization - Lighting	Tori	Vakhtang Tsitsadze	21	764	2,529	3.3	1.2	16	20	31
C10	Film Shop	Rustavi, Meskhishvili St.	- Weatherization - Lighting - Gas heaters	New House	Dimitry Vizirishvili	58.0	1,783	4,586	2.6	1.3	30	39	38
C11	Clinic	Rustavi, Meskhishvili St.	- Weatherization - Lighting - Hydronic system	Techno Therm	Omar Keguradze	22	1,403	6,983	5.0	0.8	57	75	71
C12	School #1, private	Kutaisi	- Weatherization - Lighting	Promete	Gia Chakhveladze	117	3,989	15,995	4.0	1.0	129	167	223
SUMMARY						**586**	**22,810**	**98,656**	**4.3**	**0.9**	**522**	**716**	**1,535**

Industrial Projects The industrial projects demonstrated the strongest cost-effectiveness. The average SIR of the two examples in this program is 2.0. Self-sustainable pilot projects are potentially feasible in the industrial sector.

No.	SITE NAME	SITE ADDRESS	MEASURES	CONTRACTOR	APM	ESTIMATED SITE ENERGY SAVINGS (MWh/yr)	COST SAVINGS (USD/yr)	TOTAL COST (USD)	SIMPLE PAYBACK (yr)	SIR	EMISSIONS REDUCTION		
											CO_2 (Mg/yr)	SO_x (kg/yr)	NO_x (kg/yr)
I1	Brewery "Kazbegi"	Rustavi	- Steam supply upgrade - Condensate return upgrade - Condensate heat recovery	Municipality of Tbilisi	Otar Vezirishvili	550	8,250	15,836	1.9	2.0	286	368	357
I2	AZOTI plant	Rustavi	- Repair of boiler flue - Steam pipe insulation	Municipality of Tbilisi	Omar Keguradze	1,277	8,454	17,974	2.1	1.9	674	859	829
SUMMARY						**1,827**	**16,704**	**33,810**	**2.0**	**2.0**	**960**	**1,227**	**1,186**

Vulnerable Population Projects These projects appear profitable on paper, but the probability of their successful replication is subject to review. Due to human factors, such as vandalism and lack of understanding among disadvantaged populations, projected savings may not materialize entirely. Also, the charity factor makes them less reliable as investment risks. Project VP-2, the refugee home in Rustavi, is supported by international charities. Residents would not be able to finance improvements from their own means or with their own credit.

No.	SITE NAME	SITE ADDRESS	MEASURES	CONTRACTOR	APM	ESTIMATED SITE ENERGY SAVINGS (MWh/yr)	COST SAVINGS (USD/yr)	TOTAL COST (USD)	SIMPLE PAYBACK (yr)	SIR	EMISSIONS REDUCTION		
											CO_2 (Mg/yr)	SO_x (kg/yr)	NO_x (kg/yr)
VP1	Refugee apartments	Gori	- Weatherization	Dagi Ltd	Levan Bakhtadze	42	989	2,988	3.0	1.2	14	19	73
VP2	Refugee home	Rustavi, 8 Shartava microregion	- Weatherization - Lighting - Gas heaters - Roof repair	Dila Ltd	Dimitry Vizirishvili	227	6,558	10,504	1.6	2.6	113	140	139
SUMMARY						**269**	**7,547**	**13,492**	**1.8**	**2.2**	**127**	**159**	**212**

Vulnerable Municipality Project This project serves a social purpose, but is not feasible on purely economic grounds. The cost of the roof repair lowered the cost-effectiveness.

No.	SITE NAME	SITE ADDRESS	MEASURES	CONTRACTOR	APM	ESTIMATED SITE ENERGY SAVINGS (MWh/yr)	COST SAVINGS (USD/yr)	TOTAL COST (USD)	SIMPLE PAYBACK (yr)	SIR	EMISSIONS REDUCTION		
											CO_2 (Mg/yr)	SO_x (kg/yr)	NO_x (kg/yr)
VM1	Ukimerioni Municipality	Kutaisi	- Weatherization - Lighting - Roof repair	Gasmsheni	Beso Kupreishvili	72	2,467	11,926	4.8	0.8	79	102	135

Fuel Conversion Project This project appears to be marginally feasible using the current data, assumptions and a 20% discount rate. Replication, however, would likely require financing from a development bank, as 20% is below commercial rates and too low for an energy savings performance contract (ESPC) with an energy services company.

No.	SITE NAME	SITE ADDRESS	MEASURES	CONTRACTOR	APM	ESTIMATED SITE ENERGY SAVINGS (MWh/yr)	COST SAVINGS (USD/yr)	TOTAL COST (USD)	SIMPLE PAYBACK (yr)	SIR	EMISSIONS REDUCTION		
											CO_2 (Mg/yr)	SO_x (kg/yr)	NO_x (kg/yr)
FC1	8 story apartment block	Rustavi, Meskhishvili St.	- Weatherization - Fuel switching - Hydronic system - HCAs - Lighting - TRVs - Roof repair	Gala	Revaz Kandelaki	244	15,421	64,582	3.7	1.1	229	355	896

6. LESSONS LEARNED AND RECOMMENDATIONS

In the course of carrying out this task order, the PA project managers, engineers and contractors encountered numerous situations that merit improvement. Several areas, including recommendations, are provided below.

6.1 LOCALLY AVAILABLE MATERIALS

The weather-stripping material available on the local market is substandard. It is a flimsy, plastic foam strip with a weak glue backing. Contractors had trouble installing it, some recipients refused to accept it because it would tear loose, and children often tore it loose. It is made in Turkey out of closed cell plastic foam.

Recommendations

- Start a new industry to manufacture high quality weather-stripping material in Georgia.
- Write a specification and RFP for pilot runs of extruded, hollow, silicone-rubber weather-stripping with a tight-fitting mounting ridge that fits in a routed channel.
- Distribute the RFP to companies with extruding capability.
- Pay a premium price for pilot runs (1000-2000 m) to cover start-up costs of new production.
- After testing pilot products, award the best manufacturer(s) contracts for larger quantities at lower costs.
- Use the new weather-stripping exclusively in new projects.
- Teach the manufacturers how to market the product domestically and internationally.

6.2 VANDALISM

In some projects sites, such as School #1 in Bolnisi, school children damage energy efficiency work (e.g., by tearing out weather-stripping or breaking windows).

Recommendations

- Offer more training to school administrations and students about energy awareness and the direct benefits of energy efficiency.
- Replace the low cost weather-stripping used in this USAID energy efficiency program with high quality weather-stripping manufactured locally by new businesses to be developed in the next program.

6.3 PUBLIC AWARENESS

There is a great lack of awareness among the population about:

a) How to use energy efficiency equipment. For instance, a follow up visit to School #56 revealed that one school teacher did not know how to use her thermostat. When the room got too hot, she opened the window again, as she had done all her life.

b) The benefits of energy efficiency. Many people insist on excess ventilation, more than necessary for health and sanitation. Some recipients refused weather-stripping.

Recommendations

- Prepare a short layman's presentation on the use of energy efficiency technology and its benefits. Teach it first to recipients of this year's program and next to the general public.
- Contract GAEE to organize and conduct tours of demonstration sites for clearly defined groups of various categories (e.g., homeowners, construction contractors, institution directors and staff, industrial managers and staff).
- Develop and present short "show & tell" programs for young school children around the country.
- Consider developing curricula and teaching materials that can be used to educate older students on the importance of energy efficiency.

6.4 UNDERGRADUATE ENERGY STUDIES

There are extremely few engineers in Georgia who understand the general western concepts of energy management at all levels. The local term "energy engineer" in the NIS traditionally refers to those who know how to build and operate generation systems according to old Soviet expectations. The country needs a cadre of professionals who specialize in efficiency.

Recommendation

- Offer grants to the Georgia Technical University (GTU) and other technical institutions to develop and teach undergraduate energy management courses according to USAID guidelines.

6.5 GRADUATE ENERGY STUDIES

Graduate studies are popular with students, but in Georgia's current economy there are few employment opportunities where graduates with advanced technical degrees can apply what they have studied.

Recommendations

- Teach energy engineering graduate students practical skills to meet USAID's goals in energy efficiency based on project work.
- Offer grants to Georgia Technical University (GTU) and other technical institutions to develop and teach graduate level energy management courses according to USAID guidelines.

- Use this year's projects as projects for next year's graduate theses. This would involve tracking the project's actual savings, evaluating their merit and economics.

6.6 MARKETING

Contractors in the USAID energy efficiency program tried and occasionally succeeded in selling energy efficiency upgrades to customers. This is the sort of replication that the program hopes for, but it is rare.

Recommendation

- Develop and teach a marketing course to contractors in the USAID program in which marketing and sales techniques will be stressed.

6.7 ENERGY AUDIT BASELINES

The baseline data for most of the 44 projects could be more reliable. Due to the large quantity of projects and the fact that this was the first year of this type of work, energy audits were not carried out in great detail. Rather, the PA team of analysts relied on data provided by occupants from memory. Good records were often not available.

Much of the information was estimated. Estimates usually tend to be inflated. For instance, the Aragvi restaurant project appears by analysis to be profitable, but in fact the operating times of the lights and heating system may not be as long as the owner reported. Such estimation can lead to false expectations of savings.

Recommendation

- In the future, collect more empirical data using instrumentation (e.g., metering, data loggers).

6.8 ENERGY CONSERVATION MEASURE DEVELOPMENT

Again, due to the fact that this was the first year of this type of work, PA's assistant project managers lacked experience developing sound recommendations for energy conservation measures. Estimates of future savings depend on assumptions about the future, especially about future human behavior.

For example, project VP-1, apartments of refugees in Gori, appears by analysis to be profitable, but in fact it will be difficult to sustain the savings. Vulnerable populations like refugees are vulnerable to many problems. Before the contractor was even finished building this project, thieves had tried twice to steal the new doors installed by USAID to isolate the corridors from the weather. Originally there had been no doors, and their addition was critical to energy savings. There is no practical defense against this problem. The savings predicted in this analysis may not materialize.

Recommendations

- In the future, teach energy efficiency analysts to develop energy conservation measures with more awareness of possible risks to the sustainability of the savings.

- Require peer review of proposals to screen for unrealistic estimates and assumptions.

6.9 ENERGY AUDIT METHODOLOGY

This USAID program introduced new energy auditing practice to Georgian engineers. PA Consulting taught and required methods of gathering data, technical analysis, development of recommendations, life-cycle cost analysis and report formatting. It was a significant departure from the Soviet methods the engineers had used all their lives. Some learned the new methodology fairly well in the first year while others had difficulty with the concept.

Recommendations

- Strengthen the training on current energy auditing methodology in order to improve Georgian energy engineers' work products.
- Develop and teach a short energy auditing course with practical information about how to:
  - Define a clear boundary around the limits of a project.
  - Gather reliable data.
  - Develop a baseline.
  - Analyze data.
  - Develop sound energy conservation measures.
  - Write an audit report.
- Teach this course as follow-on training to the GAEE Energy Manager certification.

Require peer review of audit reports by other Certified Energy Managers in order to obtain work products of consistent quality.

6.10 PROJECT MANAGEMENT

Most of the Georgians employed in the program as assistant project managers had little or no project management experience. They did not know how to work with contractors, keep work standards high, and ensure delivery of project milestones on time. Some seemed to be intimidated by contractors and displayed excessive tolerance for contractor performance problems.

Recommendations

- Emphasize project management skills to Georgian engineers.
- Develop and teach a short project management course with practical information about how to:
  - Write a tender.

- Select qualified bidders.
- Evaluate proposals.
- Develop checklists of action items.
- Conduct progress inspections.
- Provide thorough treatment of measures inside the project boundary.
- Recognize and address problems.
- Meet deadlines.
- Communicate reliably with the client.
- Take initiative.

- Teach this course as a follow-on training to the Energy Manager certification.

6.11 FINANCING

Very often in Georgia recipients who want to replicate USAID's demonstration projects have no access to funding, even if the potential return for a project is very high. Recipients hope for more grants, but such approaches to financing energy efficiency are not sustainable.

In energy service performance contracts, an energy service company mobilizes third party financing and guarantees some level of annual energy savings for the customer. The customer pays the ESCO in installments only if the measures perform as guaranteed. In exchange for payment of the financing charges, the customer is relieved of measure performance risk and financing the initial investment.

ESPCs work in a stable economy where risks are manageable. In Georgia, an ESPC can only work at present if external support is available. Exploring the use of ESPCs on a trial basis now will prepare local Georgians for the time when an improved economic environment permits these techniques to be used more widely.

Recommendations

- Demonstrate the concept of energy savings performance contracting by doing a "mini-ESPC" demonstration project, with USAID support.
- For the pilot project, carefully choose a site with:
  a) an actual internal budget (not donations) for paying energy bills.
  b) an SIR of around 2.0, which will yield an IRR of about 40%.
- Use project funding as a "safety net" for all three parties (the customer, ESCO and bank).

- Use project funding to cover project development costs (which are disproportionately high on small projects).
- Recruit and educate a commercial bank to provide a loan for the investment.
- Use USAID project funds to guarantee the risk, most likely in the form of an upper limit on the interest rate.
- Start the project early in 2001 in order to provide at least one year of USAID support for the project.

6.12 SERVICE

There is a need to convince contractors of the importance of follow-on service after an installation has been put into place. The end of the installation should represent the beginning of the period of service for the contractor. As was seen during the current demonstration project effort, the contractors did not pursue the opportunities to establish longer-term commercial arrangements with the consumers.

Recommendations

- Teach potential ESCOs how to provide ongoing energy service, not just turnkey construction jobs.
- For future USAID projects, build a service requirement into the local contractors' statements of work, complete with periodic inspections, maintenance and possible savings guarantees.

Conduct training of local contractors and APM to teach them what is expected under this type of agreement.

7. CONCLUSIONS

Overall, the energy efficiency project was successful in exceeding the objectives set (as described in section 2). Forty-four projects were implemented on time and within budget, including a number targeted at the more disadvantaged in Georgian society. Importantly, the project demonstrated that the use of locally available materials and equipment (although perhaps not optimal in terms of quality) can nonetheless be used successfully to save energy.

USAID is now moving into a second phase of energy efficiency promotion. The lessons learned from these demonstration projects will be used to expand efforts into new areas, such as the proposed mini-ESPC demonstration and the promotion of local industry to produce energy efficient materials.

Perhaps the most important contribution resulting from the energy efficiency project is that 53 Georgian professionals received training and became Certified Energy Managers, far exceeding the project's original training target. In addition to CEM training, these professionals also received business and specialized training, such as the weatherization methods course led by the Georgia Greens and the business management courses led by PA Consulting. During the project's execution, these professionals had important responsibilities for project design and installation; as a result, they gained both technical knowledge as well as hands-on experience and now represent a core of professionals nationwide that can be used to further develop the nascent energy services industry in the country.

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