LESSONS LEARNED

From AEAI work in Armenia on pilot project implementation

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August, 2006.

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Executive Summary

This report provides insight into lessons learned by Advanced Engineering Associates International, Inc. (AEAI) and its Energy Efficiency, Renewable Energy and Demand Side Management project team since AEAI began working on such projects in Armenia in 1999.

Designed to help project teams and program managers to improve future EE/RE/DSM projects in Armenia and worldwide, this report is based on insights from AEAI's long-term success implementing a spectrum of similar projects in Armenia through the following contract mechanisms:

- Energy Efficiency Pilot Projects Implementation Program, EPP-I-04-03-00004-00, September 30, 2005 – September 29, 2006 ($601,709)
- Armenia Energy Efficiency, Demand Side Management, and Renewable Energy Resources Program; Short-term assistance - additional energy efficiency and heat system pilot projects, No. 111-C-00-03-00101-00, October 1, 2003-September 30, 2006 ($2,989,725)
- Armenia Energy Efficiency, Demand Side Management, and Renewable Energy Resources Program; Short-term assistance – additional energy efficiency and heat system pilot projects, No. 111-C-00-03-00101-00, December 18, 2003 –September 30, 2004 ($809,530)
- Armenia Energy Efficiency, Demand-Side Management and Renewable Energy Program, OUT-LAG-I-816-98-00004-00, May 1, 2001-December 17, 2003 ($4,687,243)
- Armenia School Boiler Project, OUT-LAG-I-807-98-00004-00, March 1, 1999-June 9, 2000 ($744,023).

Activities under these programs supported USAID/Armenia's energy sector Strategic Objective 1.5 to promote "a More Economically Sound and Environmentally Sustainable Energy Sector":

- IR1: Improved Performance of Institutions for Sustainable Energy and Water Management
- IR 2: Improved Delivery of Heat and Water Supply
- IR 3: Increased Energy Security

This report focuses on the three areas: (1) human factors; (2) institutional, business and technical factors; and (3) analysis of monitoring and verification results of pilot projects. Although the lessons described in this report are derived from specific experience in Armenia, many are widely applicable to development projects in general.

We paid particular attention to the human factor. Our review of other reports found little attention paid to issues of human behavior, attitudes, knowledge, initiative, leadership and other characteristics. These issues are critical to project success, impact, and sustainability and are applicable to a range of projects both inside and outside the energy sector.

1. Human Factors

Project success and sustainability depends on clear understanding of the human factors: awareness of local business, consumer, and government cultures; collaboration and coordination with host-country staff and specialists, management style, and effective communication with USAID project Cognizant Technical and Contracts Officers (CTOs and COs) . Reviews of other donor reports suggest these issues are insufficiently addressed as part of a lessons learned analysis.

AEAI monitored, mentored and adjusted its team composition to attain strong results for each of these projects:

- Energy Efficiency Pilot Projects Implementation Program, EPP-I-04-03-00004-00, September 30, 2005 – September 29, 2006 ($601,709)
- Armenia Energy Efficiency, Demand Side Management, and Renewable Energy Resources Program; Short-term assistance - additional energy efficiency and heat system pilot projects, No. 111-C-00-03-00101-00, October 1, 2003-September 30, 2006 ($2,989,725)
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Adapting to Changing Needs: Program Management Evolution

Over six years and across five contracts, AEAI's approach evolved from an expatriate-driven and -managed orientation to one grounded on local capacity, with expatriate expertise applied as needed. Chiefs of Party (COPs)/Project Managers and long-term technical experts who fit the contract's original requirement were expected to be gradually replaced by locally-hired personnel who would take responsibility for the entire program. For the EE/RE/DSM program, this approach was fully implemented: the current COP and Deputy Chief of Party (DCOP) are both local hires with a solid record of results.

This approach requires direct attention by AEAI senior management personnel to ensure leadership transitions and project direction are consistent with program objectives and contractual terms. The knowledge transfer process extends to counterparts involved in the entire range of project activities (e.g., regulatory, finance and banking, ESCOs, educators, condominiums, and public information/awareness).

Knowledgeable, Self-motivated, Results-oriented Specialists.

The right project team is further strengthened by short-term expatriate experts with the right expertise, who are committed to and can actively advance the goal of transferring knowledge and responsibility to locally-hired staff and host country counterparts. They must be comfortable working with all levels of government, with other expatriate experts and client's (e.g., USAID, USTDA, USDOE) technical managers.

These experts often must come from outside the contractor's employee pool. This requires that the company maintain long-term contacts with experts across a range of expertise areas and that it screen them carefully. These experts often come from universities, other international development consulting companies, independent consultants and direct company hires.

The Verification Factor – Verify, verify, and then answer the question "Why?"

Pilot or demonstration projects are based on technical or financial merit. Technical merit -- energy conserved, megawatts freed, cost saved -- is generally based on a good guess. But without verifying actual savings, sustainability is unknown. Though the purpose of a pilot project is to understand the critical issues and assess results systematically, no single assessment methodology can be applied to such a range of projects. A special assessment process is generally needed for each project type and AEAI has done this special assessment through its extensive Monitoring and Verification (M&V) program.

AEAI's M&V program for EE/RE/DSM projects was implemented mostly by ESCOs from 2003 to 2006 and resulted in significant insight into how to achieve better results in the future, even where anticipated savings were not fully realized.

Based on quantitative data analysis, AEAI verified energy, environmental and cost saving potential of pilots as well as the quantitative magnitude of economic indicators and assumptions used in the calculations. Through a parallel informal survey, AEAI evaluated the comfort level of consumers during the heating season and assessed their reaction to new efficiency measures and technologies. During this process AEAI also identified technical and organizational problems with the new technologies and verified expenditures for operation and maintenance.

M&V projects were implemented by ESCOs in two stages:

(1) Measurement and monitoring of equipment in operation, and

(2) Consumers were surveyed, data collected, monitoring information processed and analyzed after the project was complete.

The following energy efficiency measures were applied in the pilot projects:

- Replacing expensive electrical heating with high efficiency gas fired boilers
- Weatherizing windows and external doors
- Installing energy efficient windows
- Installing thermo-regulating valves on radiators to control inside temperature
- Using solar collectors for hot water
- Substituting incandescent bulbs with high efficiency luminescent lamps
- Reducing standby losses by upgrading transformer substations and introducing automatic controls over the electricity supply process
- Reducing high normative losses from the electricity supply system by balancing phase loads.

Good Will Goes a Long Way: Project Selection (Public Awareness and Support)

Project selection is commonly based on the degree to which technical and financial criteria are met or exceeded. The AEAI team also considers visibility and potential impact on the community and public awareness. Projects meeting this expanded criteria include orphanages, public schools, medical centers/hospitals (for maternity and child care, heart surgery centers, etc.), and primary care-oriented polyclinics.

Such projects can also generate support for future projects, investments and reform. Projects that provide heating or weatherization for a school or clinic get noticed, and visitors often know that the American people paid for systems that support an improved learning or treatment environment and make working professionals more comfortable. Although demonstration and pilot project in commercial or industrial settings may save more energy, they have less social visibility and public awareness and education. Such research and selection can also give the local US Government representatives (i.e. US Ambassador and USAID Mission Director) the opportunity to showcase in a media event format for the benefit of both the local and national population and our counterparts that the US Government is supporting programs that have a positive impact on the day-to-day lives of the citizens of Armenia.

2. Institutional, Business and Technical Factors

Energy Infrastructure

Before 1990, energy infrastructure in Armenia followed the standards of a centralized command & control economy. The command came from Moscow, capital of the Soviet Union. Confronted with earthquake, war, and the collapse of the Soviet economy, funding for Armenia's energy infrastructure essentially stopped. The result was a rapid decline in critical components of the energy infrastructure, particularly in central/district heating systems.

USAID's investments since then to reduce building heating and cooling costs have been of significant value particularly as fossil fuel costs associated with energy dramatically increase. These projects include weatherizing with modern insulation and thermal windows, replacing inefficient portable electric heaters with central hot water systems with temperature controlled radiator regulating valves, installing multi-apartment and large public building heating systems, and provision of loss reduction technologies in electrical distribution systems.

This experience found that multi-apartment/building heating and cooling systems can be more efficient than individual apartment/room heating systems. But for the consumer such technical facts have not outweighed the benefit of their being able to control cost directly using their individual apartment/room heating systems. Technical barriers for central heating and cooling of apartment buildings or groups of them are higher than for single unit systems. Because existing heat infrastructure is not designed to provide individual unit heating (e.g., common riser piping systems without bypass or with bypass not accessible in common areas) and that in some cases these systems been out of use for over a decade has made the challenge for restoring these system significant. Hidden corrosion and damage, scale buildup/blockages, piping modifications, and removals by owners have all compounded the scale of the work.

In addition, lack of safety and environmental standards related to installation and use of individual unit gas heaters (unvented or vented to the common building vent shaft/stack) has a long-term cost to users in the form of lower air quality as well as the building due to corrosive or toxic gases in the common vent shaft/stack. Establishing a standards setting and regulatory body charged with enforcement is necessary early in the economic recovery process to constrain the use of such systems by showing the consumer the real cost of the individual apartment/room systems.

Another factor is the institutionalization of "extra fees" for certification and inspection of the ESCO's project work. It is unfortunate that low local government salaries support an environment for such extra-legal activities. The cost is borne by the ESCO as a cost of doing business. But it creates an undocumented "cost share" for the ESCO, apartment or property owner, or heat service provider and becomes another barrier to the acceptance of the legitimate cost share.

Institutional Weakness: Condominium Associations

During the years of the Soviet Union, maintenance and management of multi-apartment buildings were carried out by the state. Once Armenia became independent, housing resources were privatized and maintenance costs shifted to residents. Responsibilities for ownership were not well understood by new property owners. For apartment owners in multi-unit buildings, responsibilities for "jointly owned property, common areas, and common area maintenance" were even less understood. Consequently, maintenance investments were frequently neglected during the transition period, resulting in rapid deterioration in housing infrastructure.

Recent legal changes allow the establishment of condominiums (i.e., management bodies of shared property for common use) to eliminate state obligations for management and maintenance of common areas of multi-apartment buildings. But poor socio-economic conditions have kept these reforms from being fully applied. Only in buildings with a majority of owners able to pay for such “extras” were they successful.

Even today most registered condominiums function inefficiently or not at all. This creates a barrier to affordable heat service provision in multi-apartment buildings. This is due to a variety of circumstances:

- Psychological resistance: in the last several decades, management and maintenance of multi-apartment buildings as well as public utilities were taken care of by the state;
- Lack of a market system established on the principle of mandatory and full payment for services;
- Mistrust in collective decision-making.
- Economic conditions: unemployment and insolvency make it difficult or impossible for poor families to pay for communal services;
- Lack of qualified condominium managers resulting in poorly managed activities and mistrust among residents;
- Lack of training for managers, lack of awareness among residents in pricing and tariff formation, and lack of relevant information and methodological literature;
- Large number of empty apartments, increasing the costs for management and maintenance on fewer residents; and
- Poor communication between condominiums and private services providers.

Heat boiler systems serving multi-apartment buildings depend on active involvement by residents. In their current condition, most condominiums are too weak and financially constrained to manage such complex systems effectively. As a result, they are not able to implement measures to ensure owner interests, maintain and own common property, and contract for services to support member best interests. Some AEAI project experience suggests that condominiums can successfully organize the restoration of heating systems, take responsibility for ownership, and collect payments for heat supply. There are other experiences when ESCOs organized restoration of heating systems, maintained it and collected payments from residents.

Since most of the condominiums in Armenia are weak, their ability to mobilize residents and serve as a viable liaison between the residents and service providers/operators is not a reasonable expectation. Therefore, a long-term challenge is institutional development of condominiums to enable them to function effectively.

AEAI’s demonstration projects were successful in this area because the project teams understood these challenges. Careful selection of projects included an assessment of the strength of the condominium to perform its responsibilities and operate and maintain equipment. Management strength was less important in projects where only weatherization (e.g., repair of double windows or change to new thermal windows) and insulation was warranted. But it was more important where extensive equipment and support was required. In these cases, the preference was to find a strong condominium organization that could fund (cost share) and then maintain the systems or work with an ESCO as a heat service provider and then pair the ESCO with a functioning but not necessarily "strong" condominium. For selection between projects of equivalent technical merit, AEAI used its knowledge of the local market, condominium organizations (individuals and buildings), ESCO needs, expectations to ensure the greatest opportunity for success and sustainability.

An example is the demonstration project for a group of residential buildings at Sayat-Nova and Khanjyan Streets in Yerevan, where an ESCO is now the heat service provider for residents and responsible both for the full operation of the heating system and collection of payments.

From Beneficiaries to Stakeholders: The Consumer Factor

A decade of economic slump had a negative effect on both market performance and the solvency level of the population. When people must deal with basic survival, energy efficiency ranks low on a list of their priorities. Where commercial/industrial sector entities are able to cost share, they are preoccupied with their own business problems and would rather invest in expansion than energy efficiency. The budgets of municipal institutions are typically insufficient for even routine expenses.

The consumer factor has been one of most difficult to address. Where to find a potential project and how to convince beneficiaries to invest has been problematic, especially at the beginning of the Armenia Energy Efficiency, Demand-Side Management and Renewable Energy Program in 2001.

The following common issues were encountered in the all five sectors addressed by the EE, DSM, RE Program:

- Economic problems and subsequent financial difficulties as well as lack of affordable low-interest credits that consumers can borrow to fund EE projects
- Lack of awareness about energy efficiency. Though it's commonly known that energy is expensive, few consumers realize that efficiency brings economic benefits over the long term. For many, the payback period appears to be too long. Environmental and safety factors are last to be taken into account.
- Lack of a market-oriented mentality among consumers. People were accustomed to donors supplying 100% of the cost, both individual citizens and organizations alike. It took time for AEAI to change the ESCOs' and beneficiaries' acceptance of cost sharing. In addition, there is no common recognition that energy, including heating, is a commodity that needs to be paid for.

- Mistrust by consumers, particularly in the residential sector. Consumers are not familiar with ESCOs and often don’t believe they will receive quality heating on a long-term basis vis-à-vis what they are expected to invest. People remember failed efforts to restore heating in some urban communities of Yerevan and elsewhere several years ago. Although they failed for different reasons, two common reasons were the low quality of heating and the reluctance (or inability) of residents to pay. In these cases the heating was available for only one or two seasons after which boiler houses were shut down

Among potential beneficiaries covered by the program scope, the residential sector has been the most obstinate barrier due to the following issues:

- Low solvency level, which limits financial participation in pilot projects as well as maintenance and operational costs
- Dispersed decision making and lack of organization among residents, or the weakness of organizational arrangements (condominiums) that could work with residents, collect initial cost share, and ensure future operation of the system and payments for heat supply services. (See more on institutionalization of condominiums in the housing sector above.)

AEAI’s experience shows that beneficiaries from municipal or commercial sectors are easier to handle than individual owners/residents because a single management body is responsible for all administrative and financial decision-making. Yet doubts regarding the outcome and sustainability of the project are common for all groups. In this respect, AEAI has worked out ways to overcome mistrust by promoting transparent mechanisms related to project implementation, billing, metering and controls. The beneficiary is the third party in the project, sharing all technical and economic data as well as associated project costs objectively and transparently. Residents are free to communicate with ESCOs daily and exercise full control over the work by inspecting the site and signing the act of acceptance. By the client’s request, the ESCO may train the operator hired by the client to run the boiler house.

Consumer involvement in the pilot projects has been increasingly emphasized by USAID. The approach employed by the project team and set as a requirement for ESCOs is that consumers are not only beneficiaries but have a stake in the project, guaranteeing their commitment and capacity to operate and maintain the system. This message has been clearly and consistently communicated to ESCOs and potential beneficiaries by AEAI during meetings and discussions.

Understanding of consumer-related problems made it possible for AEAI to achieve significant progress in this area. Over last five years, financial participation by commercial beneficiaries in the projects has increased from 25-30% -- the maximum cost share size for commercial consumers established in 2001 -- to as much as an equal cost share with USAID (50%). The cost share of other beneficiaries was also raised gradually. Face-to-face communication, general publicity, the replications of demonstration projects and word of mouth have been effective in building awareness of the program among consumers and expanding the network of clients who approach ESCOs or AEAI with their own project ideas.

Energy Service Companies (ESCOs)

When AEAI began work in Armenia almost 10 years ago, few energy service companies (ESCOs) were in existence. Most were one-person shows or companies in name only. AEAI helped develop functioning ESCOs with real business skills and specialization, able to carry out work on USAID and other donor projects along with their own private (not donor-funded) business (now ranging from 10% to 60% of their total work).

Areas of specialization include:

- Assembly, repair, metal processing
- Electrical work, transformer stations, grids, gas line assembly
- Boiler installations for multi-apartment housing, polyclinics, schools, hotels, etc.
- Weatherization (roofs, windows)
- Solar systems
- Renewable energy
- Heating (building, distribution, selling, construction and maintenance)
- Hot water supply
- Turnkey construction
- HVAC

Although the number and size of ESCOs are relatively small, they are a large and valuable outcome of project activity compared to the size of investment and size of Armenia as a country. They are becoming less dependent on donor funding, with current financing fluctuating from 10%-25% (Electroshinarar /Artstrom) to 70-80% (South Term/Anergo 2).

Their success is due to the establishment and support of an active association and training and business development support that have evolved with the ESCOs themselves. Our Chief of Party worked directly with them to help them understand contract management and project scheduling and budgeting. Training focused on project management, general accounting and project financial controls as well as the use of specialized test and measurement equipment and the installation and support of various components. Study tours gave ESCOs the opportunity to see modern technologies and methods in use and discuss issues with those with experienced doing the business of an ESCO in similar environments. The establishment of an ESCO association by the EE, DSM, RE Program helped develop ESCOs organizationally to survive the versatility of the market and found their own organization for advocacy purposes and the attainment of common goals.

Project and Business Financing

Armenia's financial sector is still in its initial stages of development. According to AEAI's Energy Conservation Plan, completed in the framework of Armenia Energy Efficiency, Demand-Side Management and Renewable Energy Program, 1,318 GWh of potential savings can be realized in the energy sector alone across the residential, industrial, municipal and commercial sectors by 2020.

Most energy efficiency projects are small with relatively short payback periods. Renewable energy and multi-apartment and multi-building heating systems projects are more expensive, require a larger investment with a longer payback period and are a greater credit risk.

According to Article 6 of Government of Armenia Energy Efficiency Law, government support should be provided for financing EE and RE projects, specifically through training in energy conservation and renewable energy and support to international cooperation in these areas. The Law also states that the government will define requirements for energy efficient projects and technologies as well as priority use of renewable energy in buildings and structures built within the territories of state reserves and national parts of the Republic. To date, the government has not adopted normative or regulatory acts to support these provisions.

At the same time there is a lack of affordable financing (commercial credit) for EE and RE projects. ESCOs such as Artstrom and Technokom obtained loans from commercial banks at the same rates as those paid on regular consumer loans (18-20%). Bank costs are high because developing an EE loan portfolio requires a significant specialization and expertise. Added transaction cost, according to Converse Bank and Inecobank, can bring interest rates up to 20-25%.

Project financing is not available from Armenian banks and local financial institutions aren't experienced in bankable EE and RE projects, making it even more difficult for companies applying for EE/RE loans.

All ESCOs interviewed expressed interest in the R2E2 funding mechanism and most are hopeful it will be an effective means of financing larger heating, EE and RE projects. Most said the interest rate should be substantially lower than those set by commercial banks, making interest rate a critical factor in making energy efficiency and renewable energy projects cost effective.

AEAI has had success developing many RE and heating projects by selecting projects that could be funded with commercial financing (had such financing actually been available). These were then predominantly funded with donor support but with a cost share increasing over time. In most cases, development of the ESCOs and demonstration of technologies and methods (pilot projects) were the primary focus so that they would be applicable in large-scale. For example, installing a building heating plant in a primary school can demonstrate automated boiler controls technology, energy efficiency parameters, radiator regulating valves, flushing of heating system piping and megawatts converted from electric space heating to gas fired boiler heating. All apply to larger heating system renovation projects.

Meter Reading, Billing and Collections

In working with multi-apartment buildings it is important to build trust between residents and ESCO. Good customer relationships were achieved through different means, e.g., open and regular communication, transparent cost accounting, addressing issues connected to financial conditions of vulnerable population and discussion of proposed energy savings programs.

In some projects heat meters and allocators established a transparent and effective billing and collections system. The customer has the ability to regulate energy consumption against payment capacity. The drawback of this system is that the consumer cannot determine the exact amount of heat consumed over a specific period. In some pilot projects consumers were dissatisfied that heat allocators on their radiators were not heat meters and that they couldn't personally calculate the cost of the energy they consumed.

AEAI's experience has shown that consumers typically accept a horizontal heat distribution system with apartment-level heat meters. But this is the most expensive option.

3. Monitoring and Verification Results on Completed Projects

M&V Projects: Purpose and Steps

As part of the Armenia Energy Efficiency, Demand Side Management, and Renewable Energy Resources Program, AEAI conducted measurement and verification (M&V) of 16 pilot projects: seven from February 21 through May 2004, and nine from February 1 through June 2006[1]. The energy efficiency pilot projects were implemented by ESCOs in 2003 and 2005.

AEAI employed both quantitative and qualitative data collection methods for the following purposes:

- To verify energy, environmental and cost saving potential including quantitative economic indicators and assumptions made in the pilot project proposals
- To identify technical and organizational problems during operation of new technologies and verify operation and maintenance costs of installed equipment
- To evaluate the comfort of consumers during the heating season.
- To identify consumer evaluation of energy efficiency measures and newly installed technologies

[1] The list of projects for which measurement of verification was conducted is presented in Appendix 4 alongside with the EE technologies applied during the pilot projects.

Measurement and verification projects were implemented in two consecutive phases. In the first, the contractor for each project made the necessary measurement and monitoring of installed equipment in operation. In the second, the contractor surveyed consumers, collected data, processed and analyzed the monitoring information and performed required calculations. The M&V results were summarized and presented to AEAI on completion of all activities.

Specific steps of the first phase of the M&V projects with a heating component which continued through February through March 2004 included:

- Selecting rooms and areas for measurement purposes
- Regular measurement of indoor air temperature and humidity in selected rooms at the same hours of a day
- Regular measurements of the outdoor air temperature
- Collection of gas meter readings
- Control over the boiler house operation

The second phase began in early April and continued to the end of May 2004. Specific activities were:

- Collecting data on daily average temperature in Yerevan, Gavar, Sevan, Tsaghkadzor and Vanadzor from the Meteorology and Monitoring State Service for given heating seasons (i.e., October–April)
- Collecting information on monthly electricity expenses for the past heating season
- Conducting surveys to identify consumers' evaluation of the comfort condition during the heating season as well as feedback on pilot projects.
- Surveys to reveal problems during operation of the boiler house and to identify actual operation and maintenance costs during the heating season
- Collecting actual data on energy and cost savings as well as emission reductions for the 2003-2004 and 2005-2006 heating seasons. The annual cost saving potential and the economic efficiency indicators were verified (recalculated) for an estimated heating season.

M&V Results and Conclusions

This section of the report summarizes the quantitative and the qualitative findings from the measurement and verification of pilot projects. The quantitative component considered the effectiveness of the projects from financial and technical perspectives including financial feasibility, technical performance of systems installed at the sites, energy and cost savings, and emission reduction. The qualitative component looked at factors such as consumer-heat supplier relationships, quality of services, comfort level and consumer satisfaction.

In the following section, AEAI also explores lessons from the private heat supply project for residential buildings at Sayat-Nova and Khanjyan Streets of Yerevan and presents issues emerging during the commercialization of heat supply: development of consumer-heat supplier relationships, changes in perceptions towards heating as a commodity, billing and metering methods and consumer preferences for billing and metering options, collection rates, and consumer satisfaction[2] .

Savings and Financial Efficiency Indicators

Economic indicators for pilot projects implemented in 2005 clearly demonstrate that they were more attractive in financial feasibility (higher Internal Rate of Return (IRR)) than 2003 projects. Further analyses show that the indicators tested through monitoring and verification deviate less as training and experience is gained by ESCOs. It points to the improvement of ESCO skills and professionalism in the following aspects: (a) ability to find the best match between the project site and EE measures to achieve maximum energy saving potential and (b) ability to accurately calculate and assess energy saving potential.

Tables 2 and 3 below present annual energy and cost savings and harmful emissions reductions estimated in the pilot project proposals and verified by the monitoring and verification process. The pilot project proposals that contain a heating component were developed using the assumption-based initial estimates and implying the standardized parameters: i.e., an average winter with a standard heating season and a normative comfort level to be maintained. On the other hand, the monitoring and verification pilot projects analyzed actual parameters for a given heating season, considered actual comfort level of heated areas and tested the accuracy of indicators estimated in pilot project proposals.

The 2003-04 heating season was comparably warm in the pilot areas of Yerevan and Vanadzor, the 2005-2006 heating season almost met the parameters of a standard winter for considered regions (Yerevan, Tsaghkadzor, Gavar, Sevan, Vanadzor)[3]. Due to the characteristics of 2003-2004, M&V results of 2003 pilot projects indicated that energy and cost savings as well as the reduction of harmful emissions were substantially lower than initial estimates whereas the comfort level for all heated sites either met or approached the normative level.

As compared to Table 3, Table 4 presents adjusted values for cost and energy savings. It shows annual cost savings and economic efficiency indicators, both initial calculations and verified through M&V. If in the pilot project proposal the annual cost savings were determined using the approximate data and assumptions (weatherization factor, building thermal characteristics and others), then in the second case the annual cost saving was re-

[2] Consumer satisfaction here refers to both heating and maintenance services, as well as the supplier's feedback to consumers' complaints and problems regarding heating service).

[3] These are regions where pilot projects were implemented.

calculated based on adjusted values of the assumptions and approximate data. In both cases, calculations assumed a standard design winter and a standard comfort level.

Table 4 demonstrates that verified economic efficiency indicators for the majority of pilot projects implemented in 2003 and 2005 did not substantially deviate from initial estimates.

Operation of Newly Installed System and Equipment

The summary of monitoring and survey findings indicated a trouble-free operation of equipment installed through the pilot projects. No major malfunctioning was registered despite minor defects identified during monitoring and verification that mainly related to air cushions in pipes and radiators as well as uneven heat distribution. In rare cases, there were unexpected gas pressure reductions and water leaks from the internal heating system. The ESCO or designated maintenance staff was informed of the problems and reportedly took appropriate measures to resolve them.

EE Technologies in Pilot Projects

Past experience with EE technologies, comparison of typical projects[4] implemented over the past period as well as the M&V data analysis allowed AEAI to draw conclusions regarding financial feasibility and suitability of EE measures for certain types of project sites.

Switching from electricity to natural gas through the installation of local boiler houses has been frequently used by AEAI in the pilot projects. These were implemented in hospitals, guest house, office buildings, a school, a kindergarten, polyclinics and residential apartment buildings. The switch proves to be financially feasible and worthwhile in sites with higher levels of energy consumption. Thus, the IRR will likely to be higher in hospitals, residential buildings, orphanages, hotels and guest houses, where the same level of heat is required 24 hours a day[5]. Accordingly, the IRR will be smaller in less energy-intensive sites such as office buildings, ordinary schools and kindergartens, as well as out-patient medical institutions[6].

Heating issue also needs to be considered from social perspectives. Regardless of the IRR and other economic indicators, switching from electricity to natural gas appears to be the most optimal method of space heating for both more and less energy intensive sites. In all cases, installation of local boiler houses has obvious social benefits as it provides reliable and safe heating, and a proper comfort level required for living and working.

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[4] This section refers to the measures typically used by AEAI in its projects and tested through the M&V, therefore some of the EE technologies (such as e.g. wood drying chambers, biogas digester etc.) are not discussed here.
[5] Fuel switching to natural gas at those sites ensures comparatively high feasibility level with the IRR ranging between 38-41%.
[6] These sites are characterized by intensive energy consumption during working days/daytime whereas at nights and weekends the energy consumption is kept on a lower level. Therefore, economic feasibility of fuel switching to natural gas is relatively lower here (11-18% IRR).

System efficiency could be enhanced if installation is coupled with other EE measures such as weatherization of windows and doors, and roof insulation. In most cases, these measures (despite the installation of EE windows and doors) are affordable for consumers. For example, weatherization is an efficient and low-cost measure that provides 29-30% IRR[7]. Installation of EE windows and doors is another energy saving method, though it is more costly and less feasible (13-17% IRR) from a financial point of view. However, some beneficiaries favor this option as an investment since energy efficient windows and doors are sound-proof and have better appearance. An insulated attic is another area for energy savings and in most cases doesn't require significant investment.

Solar water heating projects implemented by AEAI show relatively low IRR - about 17%. Solar collectors in Armenia are expensive, but the country's favorable climate coupled with increases in the cost of other energy sources may well make solar technology a more popular consumer choice over time.

There is a great potential for EE in optimizing the electricity distribution network and the redesign of transformer substations. Most equipment in the distribution system is obsolete and inefficient. For transformer substations, EE measures help eliminate stand-by losses by replacing excessively powerful transformers with more optimal ones and applying the automatic change-over switches. Projects on the distribution network and transformer substations earn significant energy savings, have high financial feasibility and excellent replication potential (IRR nearly 30%). However, most substations belong to one private owner and implementation of EE measures will depend on its interest in additional investments in the technical upgrade and optimization of the distribution network.

It should be also added that along with savings and reduced values, almost all types of energy efficiency measures bring about the reduction of harmful emissions and contribute to the reduction of load demand at the PP including the peak load reduction.

Comfort and Beneficiary Assessments

The beneficiary survey found that a majority of beneficiaries (residents, office employees, patients, medical personnel and others) evaluated the comfort (the indoor temperature, microclimate, air quality) of their apartments or offices before implementation of the pilot projects significantly lower than after the gas heating system installation. Indoor comfort was rated at 3-4 points on a scale of 1 to 10. This finding is typical for schools, hospitals, kindergartens and other institutions relying on state budget subsidies. On completion of the projects, beneficiaries rated indoor comfort on the same sites as high as 8-10 points.

In addition, survey results and feedback by project clients indicated that EE measures helped improve and expand services provided by AEAI's beneficiaries to their own clients. Better conditions due to more affordable, safer and reliable heating led to increased

[7] Certainly, the IRR indicators may deviate from site to site. In those buildings where large (Soviet standards) windows are installed, weatherization may require bigger investment and therefore be financially less feasible

occupancy rates and attendance in hospitals, policlinics, educational institutions and other organizations served by the EE, DSM, RE Program: the Institute of Physics reported an increase in the number of research projects this winter, the chief doctor of the Sevan Hospital indicated that the number of patients increased 1.5 times, the guest house of Tsaghkadzor had almost full occupancy last winter compared with the previous year (allowing revenues to nearly double), and the principal of School #8 also reported higher attendance and better performance by students.

Sayat-Nova Case Study: Commercialization of Heat Supply Service in the Residential Sector

In 2003 AEAI started the project to commercialize heat supply in the residential sector. The total cost of the project was $71,700, of which the USAID and the contractor's (South Therm ESCO) cost share were $60,100 and $11,600 respectively. The project's main objective was to develop the experience of private heat supply organization in the residential sector through the locally built small boiler house. The project was based on a new, more energy-efficient and cost-effective approach to heating offered in the form of a commercial commodity measurable by consumers.

In the start-up stage in autumn 2003, South Term reconstructed the old central thermal point located at #33 Sayat-Nova Street in Yerevan into a private boiler house to provide heat to residents of the building (and later to neighboring buildings) on a commercial basis. The boiler house is equipped with high efficiency gas-fired boilers. Heat meters are installed both at the entrances and the boiler house as well as the regulating valves on apartment radiators, some of which are also equipped with allocators. In 2004 the owner of the boiler house expanded the number of consumers by connecting two neighboring multi-apartment building to the system under loan funds provided by the World Bank's Thermosupply Programs PIU. In 2005 the owner again applied to AEAI/USAID with the proposal of connecting four more residential buildings in the neighborhood. The total cost of this project was $43,300, with 50% shared by USAID. Of the total $128,000 cost of this heating initiative, nearly 1/3 was invested by South Therm.

Heat supply contracts were initially signed by residents of 80 apartments that were connected to the system during 2003-2004 heating season. Heating was supplied for 90 days at the rate of 1700 Drams per square meter of the heated area. Over 90 days, the boiler house supplied 370 MWh of thermal energy to residents (the heating bill of residents was amounted to 5,254,000 Drams). In case of electric heating at the equivalent level, the residents of 80 apartments would have to pay 9,250,000 Drams to the utility company. Switching from to natural gas allowed each apartment to save approximately 50,000 Drams (nearly $120) for 90 days of heating.

Operation and maintenance costs incurred by the supplier over the same period were 4,460,000 Drams including the fuel cost, or nearly half the amount. The remainder included the boiler house leasing fee, elimination of leaks and balancing of heat distribution, labor cost electricity and water bills and so on. The income before tax earned by the supplier made about 794,000 Dram (about $1,900). Before April the supplier managed to collect 4,608,000 Drams from residents versus the supplied heat (bill collection rate 88%).

During the M&V project at Sayat Nova 33, the contractor[8] took readings from heat meters and allocators. The average cost of services delivered to consumers was based on the energy unit consumed in apartments (according to the agreement, the service price is calculated by the heated area). NACO consumer surveys revealed the following issues: the distribution of consumers by solvency level, reasons for underpayment, customer satisfaction, and other issues associated with the consumer-supplier relationship, particularly consumer preferences concerning the methodology of pricing for the heat services provided to residents (by heated area, by readings of heat meters installed at the entrance and allocators, by readings of heat meter installed at the entrance and number of radiator sections, etc.).

M&V results found residents to be generally satisfied with services provided by the heat supplier. The apartments were heated at 18^0 C and higher, though there were some complaints regarding the air cushions and leaks in the internal heating system as well as uneven heat distribution (in this case, the temperature was recorded at $15\text{-}17^0$ C). Reportedly, the heat supplier was quick to eliminate the defects.

Residents were not satisfied with the methodology for calculating heat service cost. The methodology most preferred -- based on actual thermal energy consumed by each apartment -- appeared to be unfeasible due to the building's heating network scheme. The allocators didn't prove useful since most residents either didn't trust the readings of their neighbors or were reluctant to buy and install them.

Residents and the heat supplier found that the best and most cost effective way to calculate costs is to share the readings of the heat meter installed at the entrance proportionally to the number of radiator sections in each apartment. For his part, the heat supplier committed to ensure that apartments were heated at a temperature of at least 18^0 C, and that heat was evenly distributed through the entire heated space.

On the supplier side, M&V results indicated the following challenges faced by South Therm over heating period:

- Incomplete payments by residents upon completion of the heating season
- High boiler house leasing fee imposed by local authorities
- Disputes with the utility company regarding meter readings due to lack of a gas corrector to recalculate readings.

The measurement showed the boiler operated at 90% efficiency. With heat losses from the external line estimated at 6.6%, overall system efficiency was calculated at 84%.

[8] While the heat supply project was carried out by South Therm, the National Association of Condominium Owners (NACO) was contracted by AEAI to complete the M&V task both in 2004 and 2006.

For the 2005-2006 heating season, South Therm signed heat supply service contracts with 129 apartment owners. The heating period lasted 110 days and was priced at the rate of 11.3 Drams per one kWh of thermal energy. Over the period, the boiler house supplied consumers with 938.4 MWh of thermal energy (the heating bill due to the supplier by consumers made 10,574,000 Drams). Electric heating at the same level would have cost 23,460,000 Drams for 129 apartment owners. Switching to natural gas allowed each apartment to save approximately 100,000 Drams (nearly $240).

Operation and maintenance costs incurred by the supplier over the period made 7,304,000 Drams including the fuel cost which slightly exceeded half of this amount. The remainder included the boiler house leasing fee, payment of the loan interests, system maintenance, labor cost, and electricity and water bills and so on. The income before tax was about 3,270,000 Dram (about $7,800). Before April, the supplier managed to collect from residents 9,791,000 Drams versus the supplied heat (collection rate was now 92% as opposed to previous 88%).

The M&V showed that the boiler operated at 88.3 % efficiency during the 2005-06 heating season. With heat losses from the external line nearly 6.5%, overall system efficiency was 82.5%. The decline in boiler efficiency was due to the provider's reluctance to use the water chemical treatment station at the boiler house for clean-up of water from chemical compounds.

Over the past heating season, the consumers were much more satisfied with service, the pricing method and the cost of heating per apartment. Both the service provider and consumers indicated an increase in mutual trust and cooperation. Since both sides were uncertain as to the beginning and the end of the heating season, it was decided to use the old Soviet standards, i.e., beginning when the average outdoor temperature stays below of $+8^0$C for three days and ending when it stays above $+8^0$C for three consecutive days.

Comparing results between the 2003-04 and 2005-06 heating seasons reveals that the average consumer saved about $120 and $240 respectively without any noticeable investments. On the other hand, although the service provider increased his volume[9] 2.5 times (from 370 to 938.4 MWh) and his income (from 1900 to 7800 USD), the profitability is still not sufficient to recover initial investment in an acceptable period. The ESCO recognizes the potential for increasing profits and reducing the payback period if the number of consumers further increases. Thus, even marginal enlargement of sales and reasonable pricing can be advantageous to income. For example, expanding sales volume by 20% and establishing a service fee of 17 Drams per kWh will allow the owner of the boiler house to earn $19,000 of the annual net profit, which will pay back the initial investment within 7-8 years. Even in this case, the average consumer will still save about $140 over the heating season. Currently, the supplier deliberately maintains the heating price for consumers at a low 11.3 Drams per kWh in order to make his service more attractive for other potential users of the area as some consumers are hesitating between installing individual apartment-level gas boilers and purchasing heat supply service from the ESCO.

[9] i.e. the number of consumers connected to the network

Table 1
Annual Energy and Cost Savings

#	Project Title	Cost Savings realized by consumers(USD)		Electricity Generation Reduction (MWh)		Natural Gas Reduction (million Btu)	
		Previously Estimated	Actual	Previously Estimated	Actual	Previously Estimated	Actual
Projects implemented in 2003							
1	Residential Heating Project Sayat – Nova # 33	7800	6245	1091	496	8221	3886
2	Energy Efficient Office for the Energy Regulatory Commission Of Armenia	17700	9417	612	315	4957	3054
3	Energy Institute Boiler House Construction and Weatherization	8657	7043	353	279	3033	2394
4	Boiler House Construction With Solar Heating System at Nork-Marash Medical Center	15200	9557	575	418	4800	3662
5	School #8 Heating System Rehabilitation	15534	9549	509	411	4305	3113
6	Vanadzor Polyclinic #1 Boiler House Construction and Weatherization, ISSC Building Weatherization	14370	9616	552	295	4774	2440
7	The Transformer Substations Redesign at “Armenia” CJSC Medical Center	10514	11735	353	394	3754	4202

Pilot projects implemented in 2005

1	Local Gas-Fired Heating System Rehabilitation at Sevan Town Hospital	32830	28640	1149	1002	8588	7492
2	Boiler House Reconstruction and Weatherization at Gavar Orphan's Home	11494	10266	0	0	2996	2676
3	Boiler House and Internal Heating System Construction For Physics Institute	18424	18810	645	659	4826	4931
4	Local Heating System Rehabilitation at the Maternity Care Research Center	23892	25062	836	877	6217	6528
5	Local Gas Heating System Installation at Vanadzor Polyclinic # 4	7709	7515	270	263	1889	1840
6	Local Gas-Fired Space and Water Heating Systems Installation at the Rest House of Armenian Union of Artists	9599	9741	336	341	2294	2328
7	Solar Water Heating System Installation at Germes-Art Company	3329	3164	79	75	840	797
8	Solar Water Heating System Installation at Arabkir Joint Medical Center Institute of Child and Adolescent	2062	1950	50	47	533	506

Table 2
Annual Size of Reduced Harmful Emissions

#	Project Title	CO_2 (Mg) Previously Estimated	Actual	SO_x (Kg) Previously Estimated	Actual	NO_x (Kg) Previously Estimated	Actual
Projects implemented in 2003							
1	Residential Heating Project Sayat – Nova # 33	431	204	2.4	1.1	328	155
2	Energy Efficient Office for the Energy Regulatory Commission Of Armenia	260	160	1.5	0.8	198	121
3	Energy Institute Boiler House Construction and Weatherization	159	126	0.9	0.7	121	95
4	Boiler House Construction With Solar Heating System at Nork-Marash Medical Center	252	192	1.4	1.1	191	146
5	School #8 Heating System Rehabilitation	226	163	1.3	0.9	172	124
6	Vanadzor Polyclinic #1 Boiler House Construction and Weatherization, ISSC Building Weatherization	251	128	1.4	0.7	190	97
7	The Transformer Substations Redesign at “Armenia” CJSC Medical Center	197	221	1.1	1.2	150	168

Pilot projects implemented in 2005

1	Local Gas-Fired Heating System Rehabilitation at Sevan Town Hospital	451	392	2.5	2.2	343	298
2	Boiler House Reconstruction and Weatherization at Gavar Orphan's Home	157	140	1	0.9	120	107
3	Boiler House and Internal Heating System Construction For Physics Institute	253	259	1.4	1.4	193	199
4	Local Heating System Rehabilitation at the Maternity Care Research Center	326	342	1.8	1.9	248	260
5	Local Gas Heating System Installation at Vanadzor Polyclinic # 4	99	96	0.6	0.5	75	73
6	Local Gas-Fired Space and Water Heating Systems Installation at the Rest House of Armenian Union of Artists	120	122	0.7	0.7	92	93
7	Solar Water Heating System Installation at Germes-Art Company	44	42	0.2	0.2	34	32
8	Solar Water Heating System Installation at Arabkir Joint Medical Center Institute of Child and Adolescent	28	27	0.2	0.2	21	20

Table 3
Economic Indicators

#	Project Title	Initial Investment (USD)	Cost Savings (USD)		Net Present Value (USD)		SIR		IRR (%)	
			Previously Estimated	Adjusted[10]	Previously Estimated	Adjusted	Previously Estimated	Adjusted	Previously Estimated	Adjusted
Pilot Projects 2003 (Discount Rate - 20%, Analysis Period - 10 Years)										
1	Residential Heating Project Sayat – Nova # 33 (from consumers point of view)	0	7800	7495						
	Residential Heating Project Sayat – Nova # 33 (from the supplier (South-Therm) point of view)	71700	5721	2150	(43934)	(58906)	0.35	0.13	3	-3
2	Energy Efficient Office for the Energy Regulatory Commission Of Armenia	217700	17700	10489	(71652)	(101884)	0.51	0.3	8	3
3	Energy Institute Boiler House Construction and Weatherization	43336	8657	9341	(8003)	(5136)	0.82	0.88	14	16
4	Boiler House Construction With Solar Heating System at Nork-Marash Medical Center	81184	15216	16064	(12539)	(8983)	0.84	0.88	16	17
5	School #8 Heating System Rehabilitation	83739	15534	13240	(24580)	(27656)	0.73	0.67	11	10
6	Vanadzor Polyclinic #1	96124	14370	14341	(34657)	(34779)	0.63	0.63	9	9

[10] The data adjusted through the M&V results. For further explanation see Section B in the Summary of Results and Conclusions.

	Boiler House Construction and Weatherization, ISSC Building Weatherization									
7	Transformer Substations Redesign at “Armenia” CJSC Medical Center	37251	10514	11735	6829	10536	1.16	1.27	25	28

Pilot projects implemented in 2005
(Discount rate is a variable with the initial value of 15% which gradually decreases to 5% over the analysis period (20 years)

1	Local Gas-Fired Heating System Rehabilitation at Sevan Town Hospital	86773	32830	28640	173373	151224	2.9	2.6	38	36
2	Boiler House Reconstruction and Weatherization at Gavar Orphan's Home	52274	11494	10266	7940	7090	1.2	1.1	22	21
3	Boiler House and Internal Heating System Construction For Physics Institute	84003	18424	18810	58975	60105	1.65	1.66	21	21
4	Local Heating System Rehabilitation at the Maternity Care Research Center	84500	23892	25062	128810	135115	2.1	2.2	30	31
5	Local Gas Heating System Installation at Vanadzor Polyclinic # 4	49145	7709	7515	7262	7080	1.14	1.11	13	13
6	Local Gas-Fired Space and Water Heating Systems Installation at the Rest House of Armenian Union of Artists	31814	9599	9741	45212	45220	2.4	2.42	31	31
7	Solar Water Heating System Installation at Germes-Art Company	17052	3329	3164	7459	7060	1.37	1.32	17	17
8	Solar Water Heating System Installation at Arabkir Joint Medical Center Institute of Child and Adolescent	78999	2062	1950	4179	3990	1.35	1.32	17	17

Summary and Conclusions

AEAI successfully demonstrated a broad range of technologies, systems, and processes in energy efficiency, renewable energy and demand side management areas in Armenia. Significant hurdles were overcome to provide the greatest benefit for the least cost, while gaining the greatest impact possible from a public awareness and outreach perspective. This strategy allowed us to implement technology demonstrations and pilot projects that effectively met contract objectives as well as provided maximum benefit to various stakeholders. From a technical standpoint the selection of pilot projects based on standardized and reasonable technical criteria allowed AEAI to match project sites with the specific EE measures that resulted in the maximum energy saving for a given project.

APPENDICES

Appendix 1 – List of Pilot Projects Implemented by AEAI

Years 2002 – 2003

1. Project Name: Heat Supply Project at Energy Institute, Yerevan

Status: Completed

ESCO: Thermoservice

Total cost: 43,336 USD

Beneficiary cost share: 20%

Estimated annual cost savings: 8,660 USD

Adjusted savings – M&V data: 9,341 USD

Measures implemented: Activities included construction of the local boiler house and the gas line as well as rehabilitation of internal and external distribution systems. The boiler house has been equipped with two high efficiency gas fired boilers each at 94 kW capacity. To reduce energy losses, the radiators were furnished with the thermo-regulating valves. Windows were weatherized which decreased energy losses at least by 20 %.

2. Project Name: Boiler House Construction and Weatherization of Vanadzor Polyclinic # 1 and Integrated Social Services Center

Status: Completed

ESCO: EIICG

Total cost: 96,123 USD

Beneficiary cost share: 14% - by STP/PADCO

Estimated annual cost savings: 11,732 USD (Polyclinic) and 2,609 USD (ISCC)

Adjusted savings – M&V data: 14,341 USD

Measures implemented: Energy efficiency measures implemented in Polyclinic #1 included installation of the heating system operating on natural gas as well as weatherization. Each radiator has been equipped with a thermo-regulating valve to regulate energy consumption. AEAI has also performed weatherization of windows and doors at the Integrated Social Services Center.

3. Project Name: Heat Supply Project at Residential Building 33 on Sayat-Nova Street, Yerevan

Status: Completed

ESCO: South Therm

Total cost: 68,238 USD

Beneficiary cost share: 17%

Estimated annual cost savings: 5,721 USD

Adjusted savings – M&V data: 2,150 USD

Measures implemented: The project rehabilitated the gas-boiler house and the entire heat distribution network, and constructed the gas line. Capacity of the boiler house (1200kW) is sufficient to provide heat to nearby buildings as well. Old and worn-out pipelines and radiators in the apartments were replaced. The innovative approach in the project is that the ESCO has entered into new commercial relationship with the residents as supplier of heat. Operations have been expanded to other nearby buildings.

4. Project Name: Heating System Rehabilitation at Yerevan Pushkin School # 8

Status: Completed

ESCO: CESCO

Total cost: 83,739 USD

Beneficiary cost share: 12%

Estimated annual cost savings: 15,534 USD

Adjusted savings – M&V data: 13,240 USD

Measures implemented: The project has provided heat supply to the school building from the locally constructed boiler house equipped with 2 gas-fired boilers 250 kW capacity each. The internal and external heating networks were totally rehabilitated and the gas line was constructed. In classrooms regulative valves were mounted on radiators. The implemented measures have provided more comfortable and safe heating to school versus the old electric one.

5. Project Name: Heat Supply Project in the Residential Building at 155 Yerevanian Street, Gyumri

Status: Completed

ESCO: VN

Total cost: 61,269 USD

Beneficiary cost share: 15% - by the condominium

Estimated annual cost savings: 12,700 USD

Measures implemented: Replacement of the old electric and wooden stoves used by the residents with gas heaters. Windows in apartments were weatherized to reduce air infiltration and save more energy in apartments.

6. Project Name: Energy Efficient Office Building for the Natural Monopolies Regulatory Commission of Armenia (APURC)

Status: Completed

ESCO: CESCO

Total cost: 317,708 USD

Beneficiary cost share: 32%

Estimated annual cost savings: 17,700 USD

Adjusted savings – M&V data: 10,489 USD

Measures implemented: AEAI has managed energy efficiency component of the joint project implemented with the World Bank. The work included installation of combined heating, ventilation and air-conditioning systems in the building, renovation of windows and doors, energy efficient lighting as well as metering and controls.

7. Project Name: Energy Efficiency Project at Northern Ray Condominium, Yerevan

Status: Ongoing

ESCO: EIICG

Total cost: 193,715 USD

Beneficiary cost share: 52%

Estimated annual cost savings: 71,580 USD

Measures implemented: Northern Ray is a newly established condominium that includes the owners of 10 private two-floor houses located in the residential area near Azatutsyan Avenue, Yerevan. Under this project it is planned to lay the gas supply pipeline and install individual double pressure boilers for heating and hot water supply and also individual air-cooling chillers for each house.

8. Project Name: Boiler House and Solar Heating System Construction for Nork Marash Medical Center

Status: Completed

ESCO: Technokom

Total cost: 81,184 USD

Beneficiary cost share: 19%

Estimated annual cost savings: 15,200 USD

Adjusted savings – M&V data: 16,064 USD

Measures implemented: Under this project, heating to the Center has been provided from the newly constructed boiler house equipped with a boiler at the capacity of 1000 kW. All windows and doors have been replaced with new, energy efficient ones and the gas line was constructed. The solar water heating system of 35.2 kW installed on the roof of the hospital supplies hot water for consumer needs.

9. Project Name: Installation of 25 m^3 Biogas Digester at Agroservice farm

Status: Completed

ESCO: SolarEn

Total cost: 12,500 USD

Beneficiary cost share: 10%

Estimated annual cost savings: 828 USD

Measures implemented: The 25 m^3 biogas system operating on animal wastes was installed at a dairy farm in Yerevan. The biogas digester produces 50 m^3 (capacity of 14 kW) of methane per day used for providing hot water and heating of facilities.

10. Project Name: Energy Curriculum Development for Secondary Schools

Status: Completed

Implementer: Center for Educational Reform

Total cost: 15,057 USD

Beneficiary cost share: 15%

Estimated annual cost savings: N/A

Measures implemented: The project has developed 3 educational manuals (grades 1-3, 4-6 and 7-8) on energy efficiency and energy conservation for teachers of Armenian secondary schools. Training of teachers and students from 5 Yerevan schools was organized as well as experimental lessons were held. All the developed materials were placed on the www.schoolnet.am - network of Armenian schools - for public use.

11. Project Name: Support to Condominiums for Overcoming Barriers to Independent Operation of Boiler Houses and Heat Supply

Status: Completed

Implementer: NACO

Total cost: 27,005 USD

Beneficiary cost share: 63% - jointly by NACO, World Bank and UNDP

Estimated annual cost savings: N/A

Measures implemented: The project was implemented by the National Association of Condominium Owners and the condominiums "Argishti" (Yerevan) and "Progress" (Gyumri). Heat consumption in residential buildings was measured and monitored using heat cost allocators installed in the apartments and main point. Condominiums were provided with institutional training in the organization of residential heat supply.

12. Project Name: Electric Redistribution Project at Electric Networks of Armenia CJSC, Erebuni Branch, Yerevan

Status: Completed

ESCO: Electroshinarar

Total cost: 15,061 USD

Beneficiary cost share: 20%

Estimated annual cost savings: 20,893 USD

Measures implemented: The project was implemented in twenty electric substations of Erebuni branch each of which equipped with two transformers. The idea of this project was to redistribute the loads falling on two transformers of each substation to a single transformer. The other transformer is shut down to be re-operated as soon as the demand for electricity increases. The implemented measures have helped to increase the efficiency of transformers' operation.

13. Project Name: Transformer Substations Redesign in Armenia Medical Center

Status: Completed

ESCO: Electroshinarar

Total cost: 37,251 USD

Beneficiary cost share: 20%

Estimated annual cost savings: 10,514 USD

Adjusted savings – M&V data: 11,735 USD

Measures implemented: The project has technically upgraded four electric distribution substations of the Center to reduce stand-by losses of transformers at idle running. The automation system was renovated to ensure constant electricity supply to the center.

Years 2003 - 2004

14. Project Name: Boiler House Construction at Regional (Caucasus) Academy of Information Technologies

Status: Completed

ESCO: Thermoservice

Total cost: 48,300 USD

Beneficiary cost share: 25%

Estimated annual cost savings: 8,410 USD

Measures implemented: The boiler house was reconstructed; two new boilers as well as circulation and water supply pumps were installed. AEAI performed connection of heat transmission line from boilers to the heat network, constructed water, sewer and gas pipelines to the boilers, redesigned and renovated the water storage tank. The system was tested and adjusted.

15. Project Name: Heating System Rehabilitation for the Residential Building Entrance at 29 Khachatryan Street, Yerevan

Status: Completed

ESCO: Technokom

Total cost: 35,650 USD

Beneficiary cost share: 11% - by the condominium

Estimated annual cost savings: 4,586 USD

Measures implemented: The project included dismounting of old heating system and radiators and installation of the new heating system with regulative valves. AEAI constructed a new gas-fired boiler at the roof of the building and a gas supply network from the existing gas control point to the boiler. Weatherization of all windows and the entrance external door was performed at the site as well.

16. Project Name: Local Heating System Installation at Yerevan Polyclinic #8

Status: Completed

ESCO: Artstrom

Total cost: 54,999 USD

Beneficiary cost share: 15%

Estimated annual cost savings: 11,883 USD

Measures implemented: Weatherization of wood and metal windows (wood $33m^2$, metal $477m^2$) and construction of local gas heating system. The project has renovated the whole internal heating network together with cast iron radiators and installation of regulative valves one for each room. Three gas fired boilers with a total capacity of 290 kW were installed with necessary auxiliary equipment and gas supply network was constructed from gas control point to the boiler house.

17. Project Name: Rehabilitation of Heating System for the Second Building of Nork-Marash Medical Center

Status: Completed

ESCO: Technokom

Total cost: 47,498 USD

Beneficiary cost share: 17%

Estimated annual cost savings: 11,315 USD

Measures implemented: Installation of 60m external heat pipeline as well as weatherization of windows and doors ($230m^2$). Because of complete weariness of old heating system and radiators, dismounting of old heating system and installation of new heating system with regulative valves was preformed. As a result, comfort conditions for patients were improved dramatically as well as the performance of central and local regulation of heating system and safety regulations.

18. Project Name: Transformer Substation Redesign at ArmRusGasProm CJSC

Status: Completed

ESCO: Electroshinarar

Total cost: 37,002 USD

Beneficiary cost share: 20%

Estimated annual cost savings: 22,852 USD

Measures implemented: The main objective of this project was to reduce by half the stand-by losses of transformers by substituting the capacity of the installed transformers and adjusting it to decreased demand for energy at the site.

19. Project Name: Installation of Energy Efficient Wood Drying Complex at Anarik Kaghzvan LLC

Status: Completed

ESCO: Artstrom

Total cost: 21,100 USD

Beneficiary cost share: 31%

Estimated annual cost savings: 4,990 USD

Measures implemented: The wood drying complex installed at Anarik Kaghzvan plant is energy efficient as it functions on wood wastes obtained from wood processing. It has replaced the old self-made chamber operating on electricity.

20. Project Name: Procurement of Energy Efficient Equipment for Wood Processing Workshop

Status: Completed

ESCO: KEB

Total cost: 67,000 USD

Beneficiary cost share: 25%

Estimated annual cost savings: 19,400 USD

Measures implemented: The project has imported Russian-manufactured wood drying chambers for the production of energy efficient windows. An energy efficient wood drying complex procured by this project was installed in KEB LLC.

Year 2005-2006

21. Project Name: Private Heat Supply System Expansion in Residential Building 33 on Sayat-Nova Street, Yerevan

Status: Ongoing

ESCO: South Therm

Total cost: 21,644 USD

Beneficiary cost share: 50% - jointly by the consumers and South Therm

Estimated annual cost savings: 185 USD (each of 71 consumers) and 5,862 USD (ESCO)

Measures implemented: This pilot project is practically the follow-up activity aimed to enlarge the outcome of the demonstration implemented at the same site in 2003 and to use the entire capacities of the already installed boiler house (all the 1200 kW instead of 650 kW). Thus, 5 residential building located in the nearby territory of the private boiler house on Sayat-Nova 33 will benefit from heat supply services. Expansion of the existing external heating system to the neighboring buildings will solve the sales issue for the business and provide safe and comfortable heating to residents in winter season. The internal heating networks will be repaired including cast iron radiators (352 units) and installation of regulative valves.

22. Project Name: Heat Supply Expansion at European Regional (Caucasus) Academy, Yerevan

Status: Completed

ESCO: Thermoservice

Total cost: 51,285 USD

Beneficiary cost share: 50%

Estimated annual cost savings: 12,858 USD

Measures implemented: Under this project, the internal heating network of the Building #3 was constructed and the external heat supply pipelines (65 m) expanded to connect the building to the local gas boiler house which is powerful enough to properly provide warmth to all the buildings of the institution. The new internal heating network, including 260 cast iron radiators has been constructed.

23. Project Name: Boiler House and Internal Heating System Construction for Yerevan Physics Institute

Status: Completed

ESCO: Technokom

Total cost: 84,003 USD

Beneficiary cost share: 27 %

Estimated annual cost savings: 18,424 USD

Measures implemented: Local gas-fired heating system has been constructed at the project site including installation of a highly efficient gas boiler house with capacity of 1000 kW for space heating as well as mounting of a pressure regulating control point and low pressure gas supply pipeline to the boiler house. Weatherization of windows and outside doors was performed. Renovation of the internal heating system has involved repairing of 100 cast iron radiators and installation of 100 regulative valves.

24. Project Name: Heating System Rehabilitation at Maternity Care Research Center, Yerevan

Status: Completed

ESCO: Anergo 2

Total cost: 84,500 USD

Beneficiary cost share: 30%

Estimated annual cost savings: 36,757 USD

Measures implemented: Construction of a boiler house equipped with two gas-fired boilers with the total capacity of 560 kW, a low pressure gas supply pipeline. Renovation of the internal heating system with mounting of cast iron radiators and regulative valves for keeping desired temperature in the rooms.

25. Project Name: Heating System Installation at Armenfilm NCSO Film Studio

Status: Completed

ESCO: Anergo 2

Total cost: 35,930 USD

Beneficiary cost share: 20%

Estimated annual cost savings: 6,756 USD

Measures implemented: The gas-fired heating system has been fully constructed at the Film Studio. Specific activities included the installation of a gas-fired boiler with capacity of 95 kW, mounting of the internal heating network including cast iron radiators and fixing regulating valves in each room of the building. Gas supply network construction from gas control point to gas boiler was implemented. The project weatherized all the windows and outside doors.

26. Project Name: Heating System Construction at Sevan Hospital CJSC

Status: Completed

ESCO: Thermoservice

Total cost: 86,773 USD

Beneficiary cost share: 30%

Estimated annual cost savings: 32,830 USD

Measures implemented: The project has renovated the entire internal heating system as part of full construction of the local heating system with installation of a gas-fired boiler house with 2 boilers (180 kW + 180 kW) for space and water heating. The indoor comfort level is controlled by regulating valves. Repairing, glazing and weatherization of windows and doors of the institution’s building have been implemented as well.

27. Project Name: Boiler House Reconstruction and Weatherization at Gavar Town Orphanage

Status: Completed

ESCO: Thermoservice

Total cost: 52,274 USD

Beneficiary cost share: 20%

Estimated annual cost savings: 11,494 USD

Measures implemented: The project has provided safer and more affordable heating to 150 children hosted by the orphanage. In addition to the glazing and weatherization of windows and outside doors performed in the main building, the project has also renovated the boiler house and installed 2 high efficiency gas boilers 1000 kW each.

28. Project Name: Space and Water Heating Systems Installation at the Rest House of Armenian Union of Artists, Tsaghkadzor

Status: Completed

ESCO: Artstrom

Total cost: 31,814 USD

Beneficiary cost share: 15%

Estimated annual cost savings: 9,599 USD

Measures implemented: The project has involved the replacement of existing common type windows (54 m^2) and doors (13 m^2) with modern, energy efficient ones and roof insulation with glass cotton (170 m^2). A boiler house (30m^3) was constructed and two high efficient, double circuit gas boilers with 35 kW capacity each mounted. 4 water heaters with total capacity of 88 kW will be installed as well. The whole internal heating and hot water supply systems was renovated and regulative valves installed.

29. Project Name: Heating System Installation at Vanadzor Polyclinic #4

Status: Completed

ESCO: EIICG

Total cost: 49,145 USD

Beneficiary cost share: 10% - by STP/PADCO

Estimated annual cost savings: 7,709 USD

Measures implemented: AEAI has renovated the local boiler house by installing two 60 kW energy efficient boilers, dual gas and kerosene burners and all the supplementary equipment. The natural gas is supplied to the boiler house from the nearby mid pressure gas distribution point through a newly mounted pipeline provided for by the pilot project. The internal and external heating systems of the building were constructed and radiators in the rooms equipped with regulative valves.

30. Project Name: Heating System Installation and Replacement of Windows at Yerevan Kindergarten #47

Status: Completed

ESCO: CESCO

Total cost: 44,759 USD

Beneficiary cost share: 30%

Estimated annual cost savings: 6,858 USD

Measures implemented: The project has renovated the internal and external heating systems of the Kindergarten. Particularly, a boiler house was constructed and a gas-fired boiler at a 55 kW capacity installed. To eliminate cold air infiltration, all the windows and outside doors were replaced with new and energy efficient ones. The Program built a gas supply line from the existing middle pressure line to the boiler house. A gas pressure control unit and a gas meter center were installed. In rooms of the building thermo-regulative valves were mounted.

31. Project Name: Private Heat Supply System Creation for a Group of Industrial Enterprises in Kasakh

Status: Ongoing

ESCO: Artstrom

Total cost: 91,858 USD

Beneficiary cost share: 50%

Estimated annual cost savings: 14,304 USD

Measures implemented: In the area of the former production plant in Kasakh town there are 6 private enterprises located in each other's neighborhood, administrative buildings of which are only heated by electricity. As a middle pressure gas pipeline is laid within 200 meters from the area, the project will construct a gas-fired boiler house with 3 high efficient boilers with total capacity of 480 kW. The heat supply external distribution network including 6 heat meters will be constructed as well. Additionally the whole internal heating systems including cast iron radiators will be renovated. Weatherization activities performed at the site will include replacement of old windows and outside doors with new, energy efficient ones and insulation of roof with glass cotton ($300m^2$).

32. Project Name: Space Heating and Solar Water Heating Systems Installation at Arabkir Joint Medical Center - Institute of Child and Adolescent Health

Status: Completed

ESCO: Technokom

Total cost: 78,999 USD

Beneficiary cost share: 30%

Estimated annual cost savings: 17,903 USD

Measures implemented: The project has switched from space and water heating by ineffective electrical coils to the gas-fired option. A newly constructed and highly efficient local heating system was installed at the site. The internal heating system of the Center was renovated including 55 cast iron radiators and fixing 55 regulative valves. Repairing, glazing and weatherization of all windows and external doors was performed and a solar water heating system with a back up of gas and electricity, including 25 m^2 of flat plate solar collectors was installed.

33. Project Name: Solar Water Heating System Installation at Germes-Art LLC Company, Yerevan

Status: Completed

ESCO: Contact - A

Total cost: 17,052 USD

Beneficiary cost share: 50%

Estimated annual cost savings: 3,329 USD

Measures implemented: At this semiprecious stone processing company the solar water heating technology has been applied. The site has excellent solar exposure and the use of solar energy here promises significant energy and cost savings. The solar water heating system at the site was mounted with a back up electricity component and includes 44 m^2 of flat plate solar collectors, a 2-ton storage tank and system control components. Along with raising the process of production reliability the operation of solar water heating system will reduce environmental emissions at the thermal power plant.

34. Project Name: Replacement of Common Windows with Energy Efficient Ones at BASS Hotel, Yerevan

Status: Completed

ESCO: Thermoservice

Total cost: 29,841 USD

Beneficiary cost share: 32%

Estimated annual cost savings: 5,000 USD

Measures implemented: Replacement of the existing common type, wood-framed and double-glazed doors and windows with modern, efficient ones which will reduce heat losses by 20%.

35. Project Name: Transformer Substations Redesign at ARCS GRACIA Rehabilitation Center

Status: Completed

ESCO: Electroshinarar

Total cost: 37,830 USD

Beneficiary cost share: 20%

Estimated annual cost savings: 12,000 USD

Measures implemented: The project has performed technical upgrading of the electric transformer substations in the ARCS GRACIA Rehabilitation Center, Yerevan with the purpose to eliminate stand-by losses from the transformers at idle running. 4 high-power transformers were replaced with 3 new low-power ones to meet the daily demand for electricity at the Center. The newly installed low power transformers and the automatic system keep the reserve transformer off and automatically switch on in case of a higher demand for electricity.

36. Project Name: Electricity Distribution Network Redesign at Armenian Electrical Networks CJSC, Erebuni branch

Status: Ongoing

ESCO: Electroshinarar

Total cost: 62,500 USD

Beneficiary cost share: 50%

Estimated annual cost savings: 10,900 USD

Measures implemented: In order to eliminate sizeable power and voltage losses in the distribution network, the pilot project will perform redesigning of the network at transformer substation #165. The Program will implement “deep penetration” of high voltage for the larger number of consumers concentrated at the ends of the network. The proposed measures include mounting a new transformer substation, replacement of the existing transformer (630 kV) with a less powerful one (250 kV) as well as repair of the substation's building and renovation of the supplementary equipment.

37. Project Name: Combined Power Generation, Heating and Cooling System Installation at the Armenian - American Wellness Center, Yerevan

Status: Ongoing

ESCO: SolarEn

Total cost: 365,370 USD

Beneficiary cost share: 0%

Estimated annual cost savings: 33,683 USD

Measures implemented: The pilot project will increase energy efficiency of power supply at AAWC by applying the on-site tri-generation technology. Particularly, the CHP unit operated on gas will be installed to generate electrical power (110 kW) and thermal power (148 kW). The unit will also have independent operation option for emergency power supply in case of the utility's grid failure. In the summer, the absorption chiller will provide cooling using the heat from the CHP unit. In addition, backup batteries will be mounted to support critical loads as an emergency power supply. The project also includes the installation f the control monitoring system.

<u>**Year 2006**</u>

38. Project Name: Solar Water Heating System Installation at the Wrestling Olympic Youth Sports School, Yerevan

Status: Completed

ESCO: Contact A

Total cost: 14,300 USD

Beneficiary cost share: 65%

Estimated annual cost savings: 2,630 USD

Measures implemented: With an aim to provide the center with a reliable, safe and free water heating source, the project has installed the solar water heating system. The system was mounted with a backup electricity component including 35 m^2 of flat plate solar collectors, a 2-ton storage tank and system control components. Application of the solar water heating technology at the site will noticeably reduce harmful emissions at the thermal power plant.

39. Project Name: Heating System Installation at the RA Tax Inspection Building, Yerevan

Status: Ongoing

ESCO: Thermoservice

Total cost: 84,736 USD

Beneficiary cost share: 20%

Estimated annual cost savings: 19,515 USD

Measures implemented: The project will construct a gas-fired boiler house. Two high efficiency boilers at the total capacity of 600 kW will be installed to supply space heating. The old internal heating system will be fully renovated including the replacement of radiators and mounting of 280 regulating valves.

40. Project Name: Application of the Combat Compact Units and Gas Room Heaters at Fire Stations of the RA State Rescue Service

Status: Ongoing

ESCO: Thermoservice Ltd.; Artstrom OJSC

Total cost: 256,078 USD

Beneficiary cost share: 4%

Estimated annual cost savings: 66,674 USD

Measures implemented: 48 fire-stations around Armenia will be provided with energy efficient gas heaters to heat the shift rooms and garages. Pressure regulating control points will be installed at the sites and low pressure gas supply pipelines will be laid to the fire-stations. Gas room turbo heaters will be installed in the shift rooms. The heaters are automatic and have high-level safety protection. To protect fire engineering from overcooling, high efficiency combat compact tubular unit heaters will be installed in the garages of the fire-stations. These heaters are manufactured in USA and are designed particularly for production areas and garages. The gates of the garages will be insulated with glass cotton in order to eliminate cold air infiltration.

41. Project Name: Control System Application in the Municipal Street Lighting

Status: Ongoing

ESCO: Artstrom OJSC

Total cost: 55,085 USD

Beneficiary cost share: 30%

Estimated annual cost savings: 12,628 USD

Measures implemented: The pilot project is implemented in Nor Nork community of Yerevan and includes 19 streets with the total length of 37,560 meters. "Dispatcher" control system will be installed in the central control point which will enable to perform the following:

- At any time any street can be lighted at 1/3 or 2/3 of its entire intensity.
- Holiday lighting bulbs can be kept off all night long
- During the repairing work the energy consumption can be minimized by 2/3
- Eliminate daily check-ups
- Avoid removing holiday lighting elements
- In order to utilize the opportunities of the control system, several branches of the street lighting network will be redesigned.

Appendix 2 – ESCO Subcontractors

	ESCO	Manager	# of Employees	ESCO Activity	Address	Contact Numbers
1.	South Therm	Asatour Grigoryan	5	Heating systems construction, installation; maintenance and operation of energy systems.	33 Sayat Nova Street, Yerevan	(374 1) 541641, 562275, 587280 (3749) 400487
2.	CESCO	Ara Kocharyan	8	Architectural design of USAID building; electrical power system design; heating and cooling system design; water supply and treatment; telephone and computer network; installation/testing of security and fire alarm system.	11a Isakov Street, Yerevan, Armenia	(374 1) 562980 (374 9) 402353 201478 - Levon cesco@arminco.com
3.	Technokom	Mikhail Martirosyan	8	Renewable energy	2 Alikhanyan Eghbayrneri Street, Yerevan	(374 1) 344255 415925 technokom@web.am. m.martirosyan@technokom.am http://www.technokom.am
4.	Solaren	Viktor Afyan	25	Manufactures flat plate solar collectors and solar water heating systems, and operates as a photovoltaic system integrator. Wind data measurement, analysis and small wind turbine installation.	2/2 Shrjanain Street, Yerevan	(374 1) 777 113 Fax: (374 1) 777 182 Arthur_lalayan@solaren.com Arthur_Lalayan@solaren.am info@solaren.am http://www.solaren.am
5.	EIICG	Ashot Gevorgyan	13	Quality control and assessment of heating system renovation and modernization; Heating system audit; Air conditioning system design; Supply and installation of boilers, ovens, burners, and air conditioners; Communication and security system design and implementation.	23/5 Gyulbekyan Street, Yerevan	(374 9) 400875 556843 eiicg@yahoo.com eiicg@arminco.com
6.	Elektroshinarar	Hakob	6	Installation of heating, electric supply	24 Isahakyan	(3471) 543842, 542977; 409238

		Khachaturyan		systems, natural gas, HVAC; system maintenance; telecommunications.	Street, Yerevan	elshin@rambler.ru
7.	Artstrom	Arthur Miroyan	7	Heating; electric supply systems; natural gas; HVAC; weatherization work and system maintenance.	2a Gevorg Chaush Street, Kotayki Marz, Kasakh village	(374 1) 350630 418893 (mob.) artgroup1@yahoo.com
8.	Termoservice	Sargis Grigoryan	4	Installation of heating; electric supply systems, natural gas, HVAC; system maintenance.	25/1 Gyurjyan Street, Yerevan, Armenia	(374 1) 369246 (374 9) 432981 samy@netsys.am
9.	Contact A	Valeri Apiyan	5	Renewable energy	15/16 Charents Street, Yerevan	(374 1) 615726 vapiyan@yahoo.com
10.	Anergo Two	Karen Khachatryan	4	Installation of heating, electric supply systems, renewable energy, natural gas systems, HVAC; system maintenance; weatherization.	14 Mazmanian Street, apt.4, Yerevan – juridical address 26 Zaryan, Yerevan - office	(374 1) 251769, 258155 425322 anergo@netsys.am anergo07@yahoo.com, anergo@rambler.ru anergo@mail.ru
11.	Muzungu	Sargis Petrosyan	4	Installation of heating systems	3 A Savoyan Street, Gyumri	(041) 33874, 33862 (374 9) 497227

Appendix 3 – List of Training Courses Conducted by AEAI

Summary of Past Training Workshops and Conferences

Contract Number: OUT-LAG-I-00-98-00004-00, Task Order 816

Duration: May 2001-September 2003

<u>Implemented Trainings:</u>

- ***ESCO Establishment and Basic Business Course, 18-22 December, 2001***

This training was led by local consultants, members of the Armenian Chapter of Association of Energy Engineers (ACAEE) and covered all aspects related to the ESCO establishment and operation: legal issues, government policy in the energy sector, energy management, operation and maintenance, energy audit, project management, taxation and accounting.

- ***Certified Energy Manager, 22-26 January, 2002***

Course participants received energy manager's certificates from the ACAEE which is authorized to grant such certificates in Armenia on behalf of the AEE. This course included following topics: buildings and their thermal characteristics, determination of buildings' heat loads, central heating system, methods for providing heating energy efficiency, heat generators and their energy efficiency.

- ***Project Management Training Course, 10-13 March, 2002***

This computer based training course was conducted by Dr Hameed Nezhad. Divided into five groups, participants were requested to develop heat supply project proposals utilizing concepts and the Microsoft Project Software taught during the course.

- ***Audit Equipment Training, 1-10 September, 2002***

Course was led by Robert Erickson and William Dries for local ESCOs on the use of energy audit equipment available in AEAI's office. The class-room training was combined by on-site measurements.

- ***Planning, Monitoring and Evaluation of Energy Efficiency Projects, December 19, 2002***

This course was conducted by Dr Hameed Nezhad for ESCOs. It included the process of monitoring and evaluation during the project implementation phase, measurement and verification of energy savings, project control and risk management.

- ***Practical Course on Weatherization, April 15-18, 2003***

The course intended to improve the skills of ESCOs in performing high quality weatherization of windows and doors.

- **Certified Energy Manager's Course, May 5-7, 2003**

The course was basically intended for engineers from newly recruited ESCOs to pass the training for obtaining the qualified Energy Manager's certificate.

Workshops and Conferences:

Energy Efficiency Financing Workshop, 11-12 December 2001

The objective was to present the Draft Energy Efficiency Financing Plan and the financing models to the stakeholders from international organizations, banks, government and ESCOs, to have latter's input and recommendations for improving the EE financing mechanisms.

Heating Sector Market Development Workshop, December 20, 2001

This workshop was conducted by Dr Hameed Nezhad. It was organized for government officials, policy-makers and consultants involved in the energy sector decision-making. The workshop helped to identify institutional, organizational and management issues that need to be addressed in developing decentralized heat supply models appropriate to Armenia and recommended different ownership models for future consideration.

Government Stakeholders Workshop, April 5-6, 2002

THE PURPOSE OF THE WORKSHOP WAS TO PRESENT THE SUMMARY REPORT OF ENERGY CONSERVATION PLAN (ECP), TO SOLICIT COMMENTS OF THE STAKEHOLDERS ON ECP AND RECOMMENDED PILOT PROJECTS.

Second International Energy Conference in Armenia April 15-17, 2002

The main purpose of the conference was encouraging the ideas on future directions and strategies of the energy sector development in the region. The Conference addressed issues such as energy efficiency, development of renewable energy, energy security, energy services, environmental protection and helped to promote collaboration between energy organizations.

Revolving Loan Design Workshop June 6, 2002

The purpose of the workshop was to inform the stakeholders on the process of designing a revolving fund or other mechanism for supporting energy efficiency projects in Armenia. The workshop helped to model potential projects that would be funded by the revolving fund and to develop loan structures that best match the characteristics of the pilots.

Energy Education Workshops, July 2002

Three workshops were organized by AEAI and conducted by Dr. Nezhad:

1. Workshop for University educators to discuss models for incorporating energy education in University curriculum was held on July 11, 2002.

2. Workshop for teachers and administrators at School #132 in Yerevan, one of the pilot schools to be included in the energy education program was held on July 18, 2002.

3. Workshop for the Center for Educational Reform to provide examples of energy education materials used in primary and secondary schools was held on July 19, 2002.

Energy Efficiency Workshop in the National Assembly, December 16, 2002

Joint workshop organized by AEAI, UNDP/GEF and Alliance to Save Energy through the Armenia Legislative Strengthening Program. The objective was to inform the parliament staff and members of committees on ongoing energy sector initiatives with emphasis on the potential role of legislators in furthering the energy sector reform in Armenia.

Renewable Energy Conference, June 27, 2003

The Conference was organized jointly by AEAI/USAID, UNDP/GEF and a grant from the International Research and Exchanges Board. An international conference involved participants from Armenia, region, Europe and USA who discussed the perspectives of renewable energy development, necessary policies, current RE technologies and many more.

Contract Number: 111-C-00-03-00101-00

Duration: September 2003-September 2006

Marketing and Business Plan Development Course, March 14-18, 2005

This workshop was conducted by Dr Hameed Nezhad. It provided ESCOs with the critical skills necessary for the preparation of business and marketing plans. The training also consulted individual ESCOs how to improve their marketing strategies.

Training on Performance Contracting and Financing Options, June 25, 2005

The trainer introduced the concept of energy performance contracting (EPC), types of EPC projects, issues related to the implementation of EPC projects in Armenia and possible funding mechanisms.

Energy Audit Training – July 29 – August 4, 2005

The course was intended for those ESCOs who did not participate in the first energy audit training. Six-day course combined the class-room training with the on-site work in the Nork Marash Medical Center's boiler house and the transformer substation. The trainers demonstrated how to use measurement tools, data loggers, IR camera for performing energy audits on the sites.

Heating Options Workshop, March 5-6 2004

During this workshop AEAI presented the Draft Heating Options Report and the software to the key stakeholders involved in the heating sector development. Participants were from the Ministry of Energy, Ministry of Urban Development, Ministry of Finance and Economy, Public Utilities Regulatory Commission, ArmRusGasProm, other utility companies and international organizations. The objective was to solicit opinions and the recommendations of participants for improving both the heating options software and the report.

ESCO Association Strategic Plan Development, June 24-26, 2005

This workshop was conducted by Dr Hameed Nezhad.The workshop objective was to formulate the mission, objectives of the ESCO Association and draft the strategic plan and actions for the mid-term period.

Appendix 4 – List of Pilot Projects for which Measurement and Verification was Conducted

	Project Title	EE Measures Applied	M&V Project Contractor
M&V Projects Completed in 2004			
1	Residential Heating Project at 33 Sayat – Nova Street	Fuel switching from electricity to natural gas for heating purposes	NACO
2	Energy Efficient Office for the Energy Regulatory Commission Of Armenia	Local gas heating system installation EE lighting Installation of EE windows and doors	CESCO
3	Energy Institute Boiler House Construction and Weatherization	Local gas heating system installation Weatherization of windows and doors	Thermoservice
4	Boiler House Construction With Solar Heating System For Nork-Marash Medical Center	Local gas heating system installation Solar water heating Replacement of windows	Technokom
5	School #8 Heating System Rehabilitation	Local gas heating system installation	CESCO
6	Vanadzor Polyclinic #1 Boiler House Construction And Weatherization, Weatherization Of ISSC Building	Local gas heating system installation Weatherization	EIICG
7	Redesign of Transformer Substations at “Armenia” CJSC Medical Center	Reduction of stand-by losses from transformer substations	Electroshinarar

M&V Projects Completed in 2006

8	Residential Heating Project at 33 Sayat – Nova Street	Fuel switching from electricity to natural gas for heating purpose	NACO
9	Local Gas-Fired Heating System Rehabilitation at Sevan Town Hospital	Weatherization of windows and doors Local gas heating system installation	Thermoservice
10	Boiler House Reconstruction and Weatherization at Gavar Orphan's Home	Weatherization of windows and doors Low efficiency gas boilers replacement with high efficiency ones	Thermoservice
11	Boiler House and Internal Heating System Construction For Physics Institute	Weatherization of windows and doors Local gas heating system installation	Technokom
12	Local Heating System Rehabilitation at the Maternity Care Research Center	Local gas heating system installation	Anergo-2
13	Local Gas Heating System Installation at Vanadzor Polyclinic # 4	Local gas heating system installation	EIICG
14	Local Gas-Fired Space and Water Heating Systems Installation at the Rest House of Armenian Union of Artists	Replacement of windows and external doors with energy efficient ones Attic insulation Local gas space and water heating systems installation	Artstrom
15	Solar Water Heating System Installation at Germes-Art Company	Installation of flat plate solar water heating system with electricity back up	Contact - A
16	Solar Water Heating System Installation at Arabkir Joint Medical Center Institute of Child and Adolescent	Installation of flat plate solar water heating system with gas and electricity back up	Technokom