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GEORGIA ELECTRICITY AND NATURAL GAS SECTOR REFORM PROGRAM

NATURAL GAS USAGE EVALUATION REPORT

Prepared for:

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1. INTRODUCTION

This report has been prepared under Task Order 15 of contract LAG-I-00-98-00005-00. Based on the historical fuel consumption practices in Georgia as well as economic and efficiency indicators, natural gas is believed to be the most beneficial fuel for residential and commercial heating. The purpose of this report is to determine the benefits of natural gas usage as a primary space heating fuel in Georgia, and to evaluate fuel substitution mechanisms from existing fuel sources such as electricity, kerosene, and wood. The feasibility of conducting a pilot project in the residential sector to demonstrate the commercial viability of centralized space heating in a multi-family housing block is also included under this subtask. Recommendations for a pilot project are provided along with cost estimates and a project implementation timetable.

2. BACKGROUND

Georgian Natural Gas Sector

Construction of the Georgian natural gas pipeline network began in early 1958, and gas from Azerbaijan reached Tbilisi in 1959. By 1989, natural gas had become the single most important energy source for the Georgian economy, supplying nearly 62 percent of Georgia's energy needs, including serving as the primary fuel for the Gardabani thermal power station. Historically, gas supply in Georgia under Sakgaz was nearly everywhere; 46 cities and 230 villages had access through local distribution points, as did more than 800 industrial facilities, and about 3,500 communal installations.

Following the breakup of the former Soviet Union, the price of imported natural gas in Georgia increased substantially relative to the local economy's ability to pay. The inability of Georgia to fund gas deliveries resulted in significant internal and external debt, and a near total interruption of supply. Lack of natural gas and electricity in turn resulted in a reduction of enterprises producing export commodities, which provided currency to help pay for imported energy. Moreover, the reduction in gas supply and years of minimal investment resulted in a deterioration of system facilities. Thus, gas consumption dropped from a high of over 6.0 BCM in 1989 to an estimated 0.8 to 0.9 BCM per annum from 1996 through 1999 in the residential, government and industrial sectors.

Currently, the natural gas sector is composed primarily of companies either wholly owned by the Government as either a state-owned enterprise or JSC. The Georgian International Gas Company ("GIC") was established by Presidential Decree in 1997 as a joint stock company for the purpose of managing Georgia's main natural gas pipeline network, and to represent the State in contracts and negotiations on gas imports with foreign suppliers. Saktransgazmretsvi was established as a state-owned enterprise in 1996 by Order of the Minister of Fuel and Energy as a successor entity to the Department of Sakgaz and Saktransgaz. GIC is now responsible for the transport and wholesale supply of natural gas, and the day to day operation of the pipeline system.

In 1996, responsibility for the management of local gas distribution was conveyed to municipal governments in each locality. The State retained ownership of the distribution systems and the capital stock of each distribution company. As earlier mentioned, in January 1998 the Government began the process of privatizing several of the larger municipal gas distribution companies in Georgia. This effort resulted in the sale of a controlling interest in the municipal distribution companies Kutaisgazi, Bolnisgazi, Rustavgazi, Marneulgazi, Kaspigazi and Gorigazi. Intergaz (now renamed as Sakgaz), a Georgian subsidiary of Interpak, purchased all six distribution companies as well as controlling interest in the Rustavi cement plant, a major gas consumer.

Industry Regulation

One of the most important developments in the Georgian energy sector in the post-Soviet era was enactment of the Georgian Electricity Law in June 1997. Significant features of the Electricity Law include:

- Creation of the Georgian National Electric Regulatory Commission, renamed the Georgian National Energy Regulatory Commission in 1999, ("GNERC" or "Commission"), an independent regulatory agency with comprehensive jurisdiction over the rates, terms and conditions of service of electricity sector enterprises; GNERC has three full-time Commissioners appointed by the President of Georgia;

- Establishment of a system of licenses and tariffs to regulate the operation of electricity sector enterprises, with different requirements for generation, transmission, dispatch, and distribution licensees.

During its first full year of operation in 1998, GNERC began to set in place the framework for efficient regulation of the electricity sector. The Commission has:

- Issued interim licenses for electricity sector enterprises;

- Issued interim rates for certain generation facilities;

- Adopted a tariff methodology for cost based rates;

- Developed model licenses for generation, transmission, and distribution licensees ;
- Adopted an interim rate increase to 6 tetri per kWh (from 4.5 tetri), pending completion of longer term rate proceedings.

1999 Amendments to the Electricity Law

Amendments to the Electricity Law, including major provisions dealing with natural gas regulation, were enacted by the Parliament and signed by the President in May of 1999. The Law, as amended, is now known as the Law on Electricity and Natural Gas. The amendments dealing with natural gas establish the GNERC as the sole regulatory authority for the domestic natural gas sector in Georgia and create a system of regulation for the gas supply, transportation and distribution functions.

Licensing Regime

Under the new Law, each entity involved in the supply, transportation and distribution of natural gas within Georgia is required to have a license issued by the GNERC. The Commission is authorized to grant three types of natural gas licenses: supply, transportation, and distribution.

Natural gas supply licenses issued by the Commission authorize the licensee to purchase volumes of natural gas for transfer to distribution licensees and other customers. Gas transportation licenses will authorize the licensee to receive deliveries of natural gas and to provide transportation services to one or more distribution licensees, direct customers or delivery points. If permitted by the Commission, transportation licensees are authorized to hold supply licenses as well. The Commission is authorized to impose terms and conditions of service.

Natural gas distribution licenses issued by the Commission will grant a license holder the right to distribute natural gas to consumers within a defined geographic or distribution area. As in the case of supply and transportation, the Commission is authorized to regulate the rates, terms and conditions of service.

Natural Gas Pipeline Network

GIC is the owner of the main natural gas transmission system and the holder of a natural gas import license. Sakgazi also has an import license and transports gas through the GIC system. In return, GIC receives a transportation fee of 12.9 GEL per MCM. GIC also transports gas to the Armenian border. Pursuant to the terms of a management contract, Saktransgazmretsvi operates the pipeline system. This operating contract is due to expire in May 2000. Currently, Sakgazi provides approximately half of the cities in Georgia with at least part of their gas supply including Tbilisi, Kutaisi, Gori, Kaspi, Rustavi, Marneuli and Bolnisi.

The main natural gas pipeline system comprises a network of pipelines 1,940 kilometers in length, some of which is in need of significant rehabilitation. There are two main transit lines: a

1,200 mm diameter mainline connecting Georgia to Russia and a 1,000 mm diameter line to Armenia and Azerbaijan. The design capacity of the main system is reported to be 20 BCM, that of the North Caucasus – Trans Caucasus line is 16.4 BCM and that of the line to Armenia and Azerbaijan is 3.6 BCM. The pipeline specifications are shown in Table 1.

The age of the pipeline network, reduced usage, and lack of routine maintenance due to financial constraints have combined to result in deterioration of the pipeline and related facilities. The system is in need of significant rehabilitation including repair and replacement of existing pipe, anti-erosion measures, and the repair or replacement of corrosion protection, communication, and metering facilities

Table 1
Characteristics of the Georgian Gas Pipeline Network

Pipeline	Diameter (mm)	Length (km)	Year of Construction
N. Caucasus – Trans Caucasus	1200	135	1988 – 1994
Kazahk – Saguramo	1000	112	1980
Karadakh – Tbilisi	800, 700, 500	110	1959 – 1968
Vladikavkaz – Tbilisi	700	266	1963 – 1966
Saguramo – Kutaisi	700, 500	370	1967 – 1975
Kutaisi – Sukhumi	700, 500	338	1986 – 1989
Rustavi – Telavi – Jinvali	500, 300, 200	370	1969 – 1975
Krasny Most – Tsalka – Alastan	500, 300	180	1978 – 1990
Gomi – Khashuri – Bakurani	500, 300	59	1972 – 1989

Source: GIC

Gas Supply

Historically, Georgia received natural gas supply from Azerbaijan, Russia, Iran and Turkmenistan. Deliveries of natural gas from Turkmenistan began in the late 1980s but were curtailed in 1995 due to the accumulation of about $400 million in arrears. Russia became the single supplier of natural gas to Georgia, but arrears again accumulated and Russia began to curtail gas supply to Georgia. During that time, only the large electric generation plants and a few large industrial manufacturers received gas. District heating stations ceased to operate due to the shortage of natural gas. The supply of backup fuels, such as kerosene and heavy oil, was also disrupted due to market disarray. A few small distributors imported these fuels but deliveries were unreliable. This situation led to the current crisis witnessed in the Georgian energy sector:

- Disruption of gas supply to the residential sector and most of the commercial customers;

- Insufficient production of electric power to meet demand; and,
- Shut down of centralized heating supply for residential consumers.

To cope, residential customers turned to wood, diesel, kerosene, liquefied gas and other fuel sources in order to heat their apartments and homes. As a result, there has been serious environmental damage, including forest clear cutting and increased air emissions. Gas distribution networks and residential gas appliances have deteriorated due to non-use.

At present, in selected areas a small amount of gas is supplied to the residential, industrial, budget, and power generation sectors. Gas is also transferred through Georgia to Armenia and a transit fee is collected amounting to ten percent of the gas transferred to Armenia. The gas for both Georgia and Armenia is supplied by ITERA International, an enterprise with close ties to Russia's Gasprom. Table 2 provides the estimated gas balance for 1999 for Georgia.

Table 2
Natural Gas Balance for Georgia for 1999

Supply	**Million Cubic Meters per Day**
Received from Russia	6.11
Supplied by Georgia domestic production (Samgori)	0.2
Total Supply	*6.31*
Demand	
Transit gas to Armenia	3.90
Industry	0.25
Budget	0.03
Residential	0.16
Power/Thermal Stations - Gardabani - Tbokseli	 1.90 0.07
Total Demand	*6.31*

Source: GIC and Hagler Bailly

During the last few years, both the electric and natural gas sectors have made many significant changes, including organizational and structural improvements and progress towards commercialization and privatization. Conversely, the natural gas supply has not been restored

adequately. After being idle for five years, the gas distribution network needs serious rehabilitation and consequently major new investments. Currently, an estimated 75,000 natural gas customers are being served, compared to 750,000 customers prior to 1989. Likewise, the district heating system is still not providing service to many. The district heating sector is facing serious problems due to the inefficiency of these old systems and the lack of metering and billing for individual customers.

3. NATURAL GAS USAGE EVALUATION

Hagler Bailly evaluated the fuel types used for domestic and commercial customer heating applications, in light of the specific circumstances and economic indicators in Georgia. The following fuel sources were evaluated:

- Electricity consumption for residential and commercial heating;
- Restoration of district heating;
- Redesigning the central district heating network through installation of local gas fired boilers for each apartment building or complex of buildings where possible; and,
- Natural gas usage for space heating.

The analyses of each alternative option are provided below.

Although electricity currently is the most dominant heating source in Georgia when electricity supply is available, it is not efficient and requires increased electricity generation as well as loading a distribution system not designed to supply heating requirements. It is a primary contributor to the country's peak electrical system load. Based on the use of primary energy involved, it is also apparent that electricity is the most expensive heating source available in the Georgian market as well as one of the least reliable at present.

Currently, district heating is effectively not functioning except for a few historical consumers served by the small combined heat and power plan at Tbokseli. There have been many attempts by local governments and district heating enterprises to expand district heating. However, it is not possible to provide a commercially viable operation because the existing network is only 30% efficient, and there is no metering available such that individual customers can be billed on the basis of actual heat received. The revenue collection level is about 20% and as a result, the district heating enterprises are not functioning. To improve this system, it is necessary to upgrade existing inefficient equipment and replace regional boiler stations with individual gas fired boilers for single buildings. This approach is valuable for many commercial or industrial customers if one customer occupies the building or if there is a mechanism to allocate heating cost to a number of occupants (such as a cooperative approach). It is also possible to invest in decentralized gas fired boilers for either a single or group of apartment buildings. This would

reduce energy losses by reducing the length of the main lines, improving insulation and introducing more modern equipment. But in the residential sector, this type of system still has many weaknesses. These include:

- Existing loop-tube structure of water lines and radiators does not allow individual consumers to regulate the amount of heat received;
- Lack of heat meters and use of a normative method for heat calculation makes accurate bill calculation infeasible; and,
- There is no existing legal structure in Georgia to provide a legal basis for shared payment collection for gas received from such boiler stations. Also, the cost of maintaining the boilers has to be resolved. Although volunteer cooperatives are a possibility, the lack of a legal structure could cause serious nonpayment problems for the gas supplier. This will be an issue that will need to be addressed in the proposed pilot project, as described later.

Natural gas space heating is an option that could be considered given the fuel price, efficiency measures and the characteristics of the energy market. Preliminary estimates show that annual gas consumption for heat using individual household gas heaters would be 1,200-1,800 cubic meters per apartment at a cost of $147-$220 annually at the current price of natural gas in the residential sector (250 GEL per thousand cubic meters). For similar heat output using electric resistance heating, the costs involved would be $517 to $779. The advantages of using gas heat for residential customers include:

- With proper valving and thermostatic control, each customer can control their heat use and comfort level;
- Limits on overheating can be controlled at the boiler with hot water supply temperature controlled as a function of outdoor temperature;
- Natural gas is more affordable for the average customer due to the equipment's efficient fuel consumption and the lower price for natural gas;
- Individual metering will continue to be a problem but there is agreement with Tbilgazi that billing on a square meter allocation basis will be acceptable for this pilot.

In terms of the system benefits of substituting natural gas space heating for electrical resistance heating, the winter (and system) peak for electricity can be reduced, thus helping to improve the electric system load factor and reduce the need for new capacity. Additionally, the natural gas supply system can be expanded, an important step to increase the utilization of the strongly under-utilized gas system (only about 20% of the existing capacity is being used).

There is also the likelihood that environmental benefits will result from the fuel substitution. The combustion of natural gas is generally considered to be less environmentally damaging, relative

to the burning of other fossil fuels (coal, oil) and biomass (wood). Additionally, when natural gas is used for electricity generation (as is usually the case in the winter), there will be less overall emissions to the environment if natural gas is instead used directly in an end-use application. The tradeoff with end-use gas consumption (especially in unvented applications) is that the gas emissions are more proximate to humans and can have negative health consequences.

Given the situation in Georgia, it is likely that the human health consequences of the substitution are not significant (and may be a net improvement), due to the replacement of present heating practices (e.g., use of unvented kerosene, use of wood stoves, use of propane cooking stoves for heat) and the extent of leakage in the building envelopes. However, the environmental impact will need to be assessed more carefully as part of the environmental assessment required under USAID regulations prior to full implementation of the pilot project.

4. PILOT PROGRAM DESCRIPTION

Hagler Bailly is conducting a demonstration test of the use of individual household natural gas fired space heaters in Armenia. These units are also available in various sizes and types, including vented and unvented, in the Georgian market and have been installed by customers that can afford to pay for the gas and are in a location where gas is available.

However, eventually the gas system will be reconstructed and there will develop a market for centralized heat supply in apartment buildings as was previously done with district heating in Georgia. Thus, Hagler Bailly proposes to demonstrate the viability of providing space heat to an apartment building through the installation of a central hot water boiler at a building to be selected within Tbilisi having approximately 30 apartments. Individual thermostats will be installed at the radiators to permit individualized control of the room temperature.

The heating requirement for each apartment is estimated to be about 15,000 Btu per hour. Therefore, a central boiler with an output of approximately 450,000 Btu per hour is recommended that will provide heat to 30 apartments. A Weil-McLain LGB-5 or equivalent has been used to estimate the equipment cost. A hot water circulating pump will be installed to circulate hot water throughout the building. Thermostatic control valves will be added at each radiator to allow individual control of temperature in the area served by the radiator. The thermostatic control valve operation will be limited to a nominal comfort range. In addition, the outgoing temperature of the hot water from the boiler will be controlled as a function of outdoor temperature limiting the possibility of users wasting heat. In order to make the distribution temperature more uniform a by-pass pipe will be installed at each radiator in conjunction with the three-way thermostatic control valve. The control valve will permit the flow of water necessary to maintain temperature at a given radiator to flow through the radiator and the remaining flow to bypass the radiator. This will require an approximate one meter length of pipe to be installed at each radiator. In that no combustion of natural gas occurs in the individual apartment there is no need for CO_2 sensors or oxygen depletion sensors. Safety concerns are

minimal with this type of heating system when compared with either vented or unvented individual room space heaters.

It may be necessary to upgrade a section of the Tbilgazi distribution system to provide a sufficient volume of gas to support the space heating system. The existing system for space heating was sized recognizing that the local distribution system was expected to be used only for cooking and limited water heating. As the economy of Georgia recovers and there is an increasing demand for space heating, the local gas distribution system will have to carry an increased load given the limited role expected to be played by district heating. The proposed demonstration project will partially address this concern by upgrading a small section of the distribution system to carry the increased gas flows necessary to support the central boiler. Hagler Bailly will work with Tbilgazi to select an apartment house that can serve in this demonstration project with a minimum cost to the project.

The preliminary estimate of the program cost is based on about 30 apartments in the pilot project. The local gas distribution office will conduct a thorough examination and will recommend possible locations for the project team's further review and USAID concurrence. Table 3 provides an estimate of project costs for the conversion.

Table 3
Cost Estimate
Georgia Natural Gas Usage Pilot Project

Qty	Item	Unit Cost	Expanded Cost
1	Commercial Gas Hot Water Boiler, Weil-McLain LGB-5, 421,000 Btu output or equivalent	$25,000	$25,000
100	Danfoss RA-2000 Hot Water, 2-pipe Thermostatic Radiator Valve	$75	$7,500
1	10 hp hot water booster pump	$500	$500
1	Tbilgazi allowance for upgrade of 1,000 meter gas pipe line section	$15,000	$12,000
30	Customer Piping Allowance, Installation of Thermostatic valves	$150	$4,500
1	Installation of central boiler	$2,000	$2,000
1	Shipping of boiler, pump, and thermostatic valves	$6,000	$6,000
Contingency			$6,000
Total			$63,500

It is possible that additional equipment may be needed, such as gas leakage detectors, pipe locators, etc. to assist with restoring gas supply to the pilot site.

Additionally, Hagler Bailly recommends that the pilot project site be included in the energy efficiency demonstration projects. Further, the electric metering infrastructure at the site should be reconfigured to limit electricity losses due to theft and to help enforce disconnection for nonpayment. This will also require working with AES-Telasi. By including energy efficiency measures and electrical infrastructure improvements, the pilot will offer an opportunity to more accurately measure the impact on energy usage that can result from fuel substitution and restoration of gas.

The major difficulty that the pilot is likely to encounter is the need for ensuring payment for the gas used. As mentioned earlier, Tbiligazi has agreed to use the normative gas consumption standards for billing each household. Another option that the project team may wish to consider is some type of payment cooperative. In any case, by metering gas supply to the building, there will also be the opportunity to compare normative consumption estimates for the building as a whole with the actual metered consumption of natural gas. This may help to provide further evidence of the need to move away from normative standards and work towards individual consumer metering, or as a second-best measure in the case of centralized supply, towards a payment cooperative approach that will ensure the gas company receives payment for all gas used.

5. PROGRAM IMPLEMENTATION SCHEDULE

A detailed project schedule will be developed based on the work with Tbilgazi to define a project site and identify all measures necessary for pilot implementation. Pending USAID approval of the program concept, Hagler Bailly expects to have a final site recommendation by the end of February. A detailed work schedule indicating each activity that must be done, the responsible party and the timing will be in place by mid-March. Procurement and installation of the gas equipment is expected in the late summer with installation and start-up testing completed by early September. In order to expedite this schedule, it will be necessary to pre-qualify equipment suppliers of the boiler and thermostatic control valves.

6. MONITORING PLAN

Since the purpose of the pilot program is to determine the viability of restoring natural gas for residential space heating including rehabilitation of the gas distribution system, it will be important to gather and analyze data related to fuel use at the participating site in this program. However, Hagler Bailly's current task order end on September 29; thus, Tbiligazi may need to assume primary responsibility for monitoring and results reporting. This should be clarified with Tbiligazi ahead of time. Hagler Bailly recommends that the Monitoring Plan consist of the following steps:

- Collect information on the estimated fuels used for space heating during the 1999-2000 heating season for the apartment house selected in the program. From this data, develop an

energy use and cost profile for the building. This work will be performed primarily by Hagler Bailly staff;

- During the 2000-2001 heating season, Tbilgazi should compile information on natural gas use and payment history for the pilot participants. Hagler Bailly recommends that participants be surveyed to determine whether other fuel sources were used for heating and how effective the gas system was in providing heat and comfort improvements. Information on electricity use and costs for each household should be obtained from AES Telasi. A new energy use and cost profile can then be developed for each building and compared to the prior profile; this will be useful information for evaluating the commercial viability of using natural gas for residential heating.

Given the late September end of Hagler Bailly's current task order, USAID may want to consider including an evaluation of the pilot as a future program activity.

7. CONCLUSION

In this period of energy crisis, the Georgian natural gas industry has been struggling to recover operational capabilities and end-use consumption of natural gas is growing, albeit slowly. Current use of natural gas is far below historic levels and thus, there is significant capacity in the existing network for increasing end-use gas consumption in the country.[1] This limited use of distribution capacity causes major problems for the effective distribution of gas.

At the same time, the decline in the use of gas and district heating witnessed in the early 1990s led to substantial substitution of electricity for a number of end-uses. Of greatest concern to the overall energy system is the substitution of electricity for space and water heating requirements. This has led to an imbalanced power supply situation with winter loads being driven strongly by residential space heating loads in spite of the limited power supply available. Given the impact of electric resistance heating on the power system and the need for rehabilitation and expansion of the gas network, the pilot project described in this report is designed to enhance the efficient use of both the gas and electricity network.

The proposed pilot demonstration project will provide useful insight into the costs, impacts and program implementation issues associated with expanding the use of gas through replacement of electricity (and other fuels) for space heating needs. Additionally, although increasing the current commercial risk of the project, use of a centralized system demonstration will provide useful information regarding the option of providing a safe, long-term space heating solution for the

[1] It should be noted that the amount of space heating load that could be substituted to gas would be constrained somewhat by the size (diameter) of the distribution network. The gas distribution network was not sized for significant distributed space heating loads. The issue of an approach to rehabilitate the system to meet will be part of the objective of this demonstration project.

existing multi-family housing inventory. If the commercial risk of collection can be overcome in this major element of the housing sector, the confidence in the applicability of the program design to all areas of Georgia housing will be heightened considerably.