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COAL RESOURCE EVALUATION REPORT

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EXECUTIVE SUMMARY

The Georgian coal industry is near collapse as a result of declining coal markets, the decline of the industrial base in Georgia, and the disruption to regional markets caused by the demise of the former Soviet Union. In 1960, Georgian coal production was 2.9 million tonnes with total domestic demand approximating 4.1 million tonnes per year. By 1985, domestic production decreased to 1.7 million tonnes and demand was 2.1 million tonnes per year. Coal markets have since declined to a level of about 10,000 tonnes per year. The primary issue investigated by this report is whether there appears to be economic potential for the Georgian coal industry.

Georgia has three coal fields which have been or are considered as economic. The only coal field that is currently considered as having economic potential is the Tkibuli-Shaori coal deposit located about 30 km northeast of Kutaisi, in central Georgia. In our opinion, the coal reserve is defined at the same level of quality as is often observed in western coal mines. Georgian standards employed to define the Tkibuli-Shaori coal reserves are roughly comparable to western standards, except the definition of economic reserves differs and therefore requires discretionary consideration. Tkibuli Shaori coal occurs in six separate seams ranging in thickness from two to ten meters with non-coal layers between them ranging from one to three meters in thickness. The total coal section being mined ranges from 17 to 32 meters within the reserve and the number of mineable seams also varies. The coal seam dips, in the current area of mining, about 30 to 40° as measured down from horizontal. In addition, the ground surface over the coal seam increases dramatically such that the total section of geologic material over the coal seams increases to a maximum of about 1700 meters.

By Georgian standards, there are 332 million tonnes of coal classified as coal reserves which could be mined and are economic. Our review of coal reserves was limited to quantities likely to be mined in the vicinity of the proposed mining operations in order to meet market demand. In total, Georgian estimates of coal in this limited area which could be sold to market, after considering geological losses and mining recovery rates, are 62 million tonnes. It appears a safe conclusion from our review of coal reserves that adequate resources exist to support a mining operation producing approximately 750,000 tonnes of coal per year for at least 20 years. Currently, given the depth of our investigation and the methodology of Georgian standards it is impossible to determine the quantity of reserves that can be classified as economic reserves.

The Tkibuli Shaori coal reserve is being exploited by five separate underground mines operating as the Tkibuli mine complex working the same seams of coal from different locations within the same region. Two of the mines, the Tsoulikidze and Western, have depleted their economic coal resources and require closure. The Western 2 mine is under development and two other mines, Mindeli and Imereti, have been producing coal for quite some time. Mining at Tkibuli is rather

unique because the total coal seam thickness mined and recovered by underground methods is rather high. Primary access to coal seams is provided by a three-kilometer tunnel driven horizontally from the earth's surface. This provides the primary ingress and egress to the mine for men, materials, ventilation, waste-rock and coal products. Two vertical underground shafts and additional development tunnels in the footwall (underneath) of the seam then continue the development workings to the seam. All seams of coal are extracted in a sequential order from top to bottom employing a breast-and-pillar mining method employing timber roof support coupled post-mining with a roof-caving method.

Mining is currently being conducted at a depth of 300 to 400 meters below the main access tunnel, but because of the increasing ground elevation the thickness of earth above the mining area is about 900 meters. As mining continues down dip, the thickness of earth over mining areas increases which causes mining costs due to ground pressure, maintenance of underground openings, higher coal losses, and increase in ingress and egress costs to increase. The mine has no water but does experience spontaneous combustion and methane gas problems from the caved areas. Solutions have been devised to deal with these issues. Mechanization in the mines is limited to ventilation, coal drilling and transportation for men, materials, coal and waste rock. Coal is excavated by blasting and manual labor.

The coal being mined appears to be a bituminous A coal, by American Standards for Testing and Materials standards. The coal has high carbon (79%), volatile matter (42%), and heat content (7,500 kcal/kg or 13,500 btu/lb.), on a dry ash free basis. The coal seam contains high ash content (33%) such that upon mining the ash in the coal ranges from 30 to 40%. This results in a coal product with a heat content of about 4300 kcal/kg (7,740 btu/lb.), which is quite low in contrast to coal available on the international coal market. The coal's sulfur content ranges from 0.5 to 1.5 and averages about 1.2%, which is acceptable from a market perspective.

After mining, the coal is no longer beneficiated to rid the coal of ash and sulfur content. An old processing system, based on technology from the early 1950s, is no longer useful. In the past, success has been achieved in removing ash from the coal. The capability to beneficiate the coal is important because a coal with higher quality will travel farther within the market and will attract higher prices. We recommend Tkibuli coal be analyzed by western beneficiation experts to determine the potential to clean the coal and develop a better coal product. If these tests are successful, a feasibility study may be warranted such that plant design and economics can be determined. This evaluation is critical to properly determining the best possible market for Tkibuli coal. If the coal can be significantly beneficiated, it may open the door to regional international markets and hard currency.

Our analysis of Georgian coal production economic information indicates there is potential for economically profitable operation of the Tkibuli mine complex. Our evaluation shows that if a $30 market price, FOB mine, is reasonable then an internal rate of return of 10 to 15%, after income tax, may be achievable. In order to attract outside investment, it is reasonable an investor will require a rate of return of at least 20%, after tax. However, in our opinion, additional marketing work is necessary to adequately support coal volumes and prices

assumptions in the economic analysis. Otherwise, an international investor would review the marketing plan, discard it as unfounded, and lose interest in the Tkibuli mines. We are of the opinion that there may be opportunity to reduce projected operating costs. We recommend that a global review of mines with similar geologic and mining conditions be conducted to determine if there is a model that can be used to increase mechanization and reduce labor. We also recommend computers be purchased to allow a more flexible and rapid assessment of mining options and economic reassessment.

An important criteria concerning the potential for economic operation of the Tkibuli mine complex is the fact that it is the only producing mine within the southern Caucasus region that has significant production potential. We also have determined that international coal suppliers can not effectively compete within the southern Caucasus region. Therefore, in this market region, Tkibuli coal would certainly be an attractive source of supply, if adequate demand exists. An important question to be resolved is whether the regional coal market will re-emerge or whether a coal market can be encouraged to re-emerge as the economy stabilizes.

The primary market planned within mine economics is a coal-fired power station proposed for construction near the Tkibuli mines. An agreement has been signed by Georgian and Slovakian interest to build a 125 MW conventional power station within the next few years. This agreement calls for immediate investment and apparently has arranged the required financial sources. This power plant would have to compete for power sales under the terms of the new free market electricity plan that is currently being implemented in Georgia. Nonetheless, our analysis shows that this power station would not be able to compete in a free market system because the investment and operating costs are significantly higher than comparable natural gas plants at current market prices. In our opinion, this plant may not come to fruition because of project economics or the plant will be constructed and fail to compete within the market place.

If the coal-fired power station is constructed and the power sector is forced to accept all the electricity produced by the plant then the electricity consumers of Georgia will pay an unreasonable cost for the produced power. We forecast that the cost to consumers will range from US$35 to $60 million per year. This additional cost will make Georgian products more expensive and less desirable in international markets. The negative impact to the Georgian economy from increased power costs is likely much greater than the cost to spur economic development of the Tkibuli region. For this reason, we place more importance in developing coal markets other than the Tkibuli coal-fired power station.

Given our understanding of Tkibuli's competitive position in the southern Caucasus coal markets, we recommend that a more thorough marketing assessment and feasibility study be completed. We recommend the regional coal market be investigated in depth to more thoroughly understand coal markets and competitors such that the true market region wherein Tkibuli coal is competitive can be determined. For example, it is of interest that the Armenian coal market has declined from 400,000 tonnes per annum during the past few years and that Armenia has been looking for domestic coal for a hypothetical coal-fired power station. Armenia represents a potential opportunity for Georgian coal suppliers. We recommend Armenian and other regional

markets be thoroughly investigated to determine market potential. This example demonstrates an opportunity that may exist elsewhere in the region where Georgia may effectively compete against Russian, Ukrainian, and Khazak coals that have the disadvantage of high costs, great transportation distances, subsidies that are at risk, and/or high sulfur content. Existing marketing assessments are inadequate and do not fully investigate market potential, distribution networks, incentives to create markets, or transportation costs. In all material we reviewed, we found no analyses that properly evaluate natural gas or other competitive fuel costs and issues such that market conditions were adequately understood.

The current business plan is out of date. We recommend that a new business plan be developed which defines achievable goals, establishes action plans to achieve these goals, and creates a mechanism to review, on a monthly basis, success in achieving these goals. Marketing issues need to be recognized in this business plan.

After market issues are thoroughly analyzed and potential cost savings are investigated, mining economics should be revised to determine economic reserves and more accurate economic indicators for the Tkibuli mining complex. At that time, it should be determined what impact the value-added tax has upon mining economics. If it is appropriate, industry should request tax relief from the Government of Georgia.

The Tsoulikidze and Western mines require closure. They negatively impact the economic potential of the operating mines and pose a potential environmental issue due to water flows from the mine which could be acidic in nature. Regardless of the future of the Tkibuli mine complex, these mines need to be shut down. If the Tkibuli mine complex doesn't have private ownership interest in the offing, then we recommend a comprehensive closure plan is developed and international donors approached to assist in closing these mines. We recommend that closure aspects be separated from social mitigation impacts and that social mitigation impacts be treated by an overall economic revitalization plan for the Tkibuli region.

We recommend economic and social problems in the Tkibuli region be severed from mine management responsibility and that government and community officials develop a plan to revitalize the Tkibuli region economy. This effort should assume the Tkibuli mine complex will not be the savior as expected and that other economic support bases must be developed. The Tkibuli economy suffers from years of reliance upon a single economy and therefore needs to be diversified. This plan should focus on building small business within the region, from the roots up. We recommend that a concept be developed and presented to international donors in order to gain their experience and support in developing a regional economy.

In summary, it is not possible to produce a definitive conclusion about the economic potential of the coal industry in Georgia because of the lack of information. Coal reserves appear adequate to support near term markets. Mine operations appear to be economic and may have potential for reduced operating costs. Markets are lacking. One thing is certain: There is currently little active coal demand so new markets must be developed or old markets revitalized. Therefore, the potential revitalization of the Tkibuli mine complex lies at least 3 and more likely at least 5 years

out in the future. Beyond the question of economic potential of the coal industry, it is necessary to address the economic situation in the Tkibuli region by assuming there is no coal industry, and depleted mines be closed.

A summary of recommendations is provided below:

Proposed Tkibuli Mining Complex Work Plan to Develop a Cost Effective Industry

1. **Determine if a better coal product can be produced through coal beneficiation.**
2. **More thoroughly investigate the regional coal market and competitors.**
3. **Refine the understanding of the coal market to support re-development of the economic feasibility study.**
4. **Conduct a global review to establish if a model mine exists which could guide cost reduction efforts for the unique Tkibuli mining complex and obtain computers and training to assist in alternative cost and economic evaluations.**
5. **Redevelop mining economics to incorporate improved market intelligence and potential cost savings, and specifically determine economic mine reserves proven by the feasibility study. Determine whether economics are dependent upon tax incentives, and approach the Government of Georgia about tax modification, reduction, or elimination.**
6. **Develop a new business plan and re-develop this plan annually.**
7. **Develop a comprehensive plan to close the depleted mines, immediately. Remove social mitigation costs from closure costs and ensure costs only reflect the true responsibility of Tkibulnakshiri. Request assistance from the international community if no private investors are involved in the project.**
8. **Transfer the responsibility for developing an economic restructuring plan for the Tkibuli region to the Government of Georgia, where it belongs, and develop a plan to mitigate economic problems in the region by revitalizing the economy with non-coal related programs. Request assistance from the international community in order to reap the rewards of their experience and assistance with these issues.**

INTRODUCTION

I.1 IMPACT OF INDEPENDENCE ON THE ECONOMY

In April of 1991, Georgia declared its independence from the Soviet Union and was one of the first republics to do so. Georgia has a population of about 5.4 million within a land mass encompassing 70,000 square kilometers. Neighboring countries include Turkey, Armenia, Azerbaijan, and Russia while the Black Sea, in the west, offers access to the oceans of the world. Georgia's separation from the Former Soviet Union, FSU, caused regional and internal conflict that resulted in a free fall of the Georgian economy. Production dropped, unemployment increased, and inflation reached astronomical highs of 8,400% in 1993. Previously, Georgia's economy was deeply integrated with the Soviet economy, which also suffered severe transition difficulty, so while ties were being broken, Georgia's economy suffered greatly, much like the remainder of the FSU.

I.2 IMPACT OF INDEPENDENCE ON THE COAL INDUSTRY

The Georgian coal industry has produced over 100 million tonnes of coal since it was first exploited in 1846 at the Tkibuli-Shaori coal deposit. Up until about 1990, the Georgian coal industry was based upon three coal deposits, all of which were being exploited to produce coal. As a result of production and market pressures during the nineteen eighties, output was reduced by about half before the end of the decade.

Brown coal at the Akhaltsikhe deposit in central-southern Georgia was discontinued in the mid-eighties because of the difficulty of thin seam mining by underground methods in poor geologic and deep conditions. The Tkvarcheli coal deposit is located in the northwest Georgian region of Abkhazia. Coal production there has ceased due to war-related damage to the power station, which is the primary market for the coal. Because of continued strained relations between Georgia and Abkhazia, this report does not consider the potential of coal production from the Abkhazian region. Given the status of these two mines and the apparent absence of other economic coal reserves, this report focuses only upon the third deposit, the Tkibuli-Shaori coal resource. It is located about 40 kilometers north-northeast of Kutaisi, in central Georgia. It is currently being mined at drastically reduced rates because of the impact of severing ties with the Former Soviet Union, separation impacts on the economy, and the difficulties imposed by competing in a new free market system.

The immediate impact of independence upon the coal sector in Georgia was that of thrusting the coal sector into a free market system. Previously, under centralized planning, profitability and economics did not play a guiding role in business planning and coal marketing. The Soviet central government dictated where coal would be shipped, what prices would be paid and what subsidies would be provided to industry. In addition, the high level of energy consumption per capita played a role in raw fuel consumption levels. After independence, Georgia immediately adjusted its energy per capita consumption levels to norms near the averages observed in non-FSU regions. This change, of course, affected all raw fuel suppliers, including coal. Once Georgian independence and a free market economy were declared, the Georgian coal sector was required to become self sufficient from a market perspective. The coal produced in this new setting had to be more competitive from economic and quality perspectives. Nonetheless, the transition was not immediate and the Georgian government still subsidizes Tkibuli coal operations to a limited extent.

The coal mined from Tkibuli coal deposit is of a lower quality and of higher cost than many coal products available on the international coal market. Coal must not only compete with other coal products but must also compete with other raw energy sources that are in plentiful supply in the southern Caucasus region. Domestic coal markets dried up as natural gas and mazut (fuel oil) replaced coal in its traditional markets. Competing against oil and gas as well as the impact of the falling economy upon unprofitable coal consumers have taken their toll on production from the Tkibuli mines. Coal markets have eroded such that production from the Tkibuli mines has essentially dropped from about 1.2 million tonnes in 1980 to less than 10,000 tonnes in 1999.

I.3 CURRENT STATUS OF THE COAL INDUSTRY

All coal mining potential in Georgia, at the present time, comes from the Tkibuli coal mine complex. The primary questions facing Georgian coal industry professionals is whether the Tkibuli mines are competitive and whether markets can be redeveloped. New coal customers, who can pay for the coal, at profitable prices, must be found or the mines will have to be closed.

The Tkibuli-Shaori coal resource is contained within a synclinal (bowl shaped) geologic feature wherein the maximum depth to the coal from ground surface is 1700 meters. The coal horizon ranges from 17 to 33 meters thick and contains up to six mineable coal seams from 1 and 10 meters thick. The coal-bearing geologic section dips up to 50° (as measured down from the horizontal) at the sides of the syncline while it dips in the 0 to 10° range at the bottom of the syncline. Mining is currently being conducted on the southern flank of the syncline where dips range from 30 to 40°. Access for mining is by vertical shafts, winzes, haulage drifts, and access drifts to allow mining by underground methods.

There are four mines at the Tkibuli mine complex that can produce from the Tkibuli-Shaori coal resource coal and one partially constructed future mine. The Imereti and Mindeli mines hold promise for current and future production while the West and the Tsoulikidze mines have

exhausted their coal reserves and require funds in order to properly shut down these old operations. The Western 2 mine is the partially constructed mine. Coal produced from these mines is not beneficiated or cleaned in any way. Coal beneficiation practices were abandoned in 1995 due to operational and market considerations. The coals are classified as G, gassy, and D, long-flame, by Russian Gos Standards. Because of the high carbon content, U.S. standards would likely classify this coal as a bituminous-A coal. After extraction, the coal has a poor heating value because a high quantity of ash, as a result from both depositional features and mining methods, is retained in the product coal. From a utilization perspective, it must also be recognized that this coal has a high volatile matter content such that coal combustion units must be designed for this particular type of coal. The combustion units must have a more expansive combustion chamber to account for the higher levels of expansive gasses emitted during coal burning operations. This is a normal consideration for coal combustion. Coal markets for this coal, primarily because of the high ash content, have almost disappeared.

On September 16, 1999, Presidential Resolution #1136 and Presidential Decree # 543 were issued in the Republic of Georgia. The resolution created the foundation of a working group to address coal utilization and consumption issues. The group is headed by Mr. Merab Chxenkeli, Minister of Urbanization and Construction, and has a mandate to submit a draft of a regional coal utilization and consumption program. The decree resolved that a proposal concerning the construction of a 2X125 Mw power station by a Slovakian business group be accepted. It was noted that the construction was to be entirely financed by private investment without bank guarantees by the state. The decree required actions to implement the decree and stipulated a schedule of required implementation dates.

I.4 DECISIONS NECESSARY FOR THE COAL INDUSTRY

Regional coal markets have disappeared during the last 19 years. If the Georgian coal industry is to survive, new coal markets must either be found or developed. If coal markets can be found for Tkibuli coal, the question that must be answered is whether development of production capacity is worth the capital investment and operating costs to continue mine operation. It is necessary to determine if Tkibuli coal products can compete against other forms of energy in a transparent and competitive free market.

If Tkibuli coal production is deemed to be competitive then investment will be necessary to prepare the Imereti, Mindeli, and Western 2 mines for production at levels supported by economic feasibility studies. Regardless of this potential, investment is required to shut down the West and the Tsoulikidze mines. The purpose of this report is to assess the potential of the Georgian coal industry to develop cost-effective coal resources. The conclusions drawn from this report are intended to assist interested parties in making decisions that are based upon economic and technical considerations.

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If it can be concluded that further production from the Tkibuli mine complex is not economically viable then a decision to close all four mines in an environmentally acceptable manner should be made. This action then requires that the social ramifications of closure be addressed. Because of the risk the regional Tkibuli economy faces due to their heavy reliance upon the Tkibuli mine complex, a decision should be made to immediately address social issues.

Beyond these decisions, the government of Georgia must make a decision concerning the value of the coal industry relative to national security. The value Tkibuli provides the country of Georgia by being able to provide raw energy in the form of coal must be established in economic terms. This requires that the use of coal, when national security issues are of paramount importance, be understood to properly analyze the role coal resources would play under this condition. In addition, the cost-benefit of subsidizing the coal industry must be analyzed and compared to other expenditure options to assist the Government of Georgia, GoG, in making a decision. The question of coal industry subsidization is very important because it has proven to be very expensive in countries such as Germany, Ukraine, and Russia. Georgia is now in a situation where the expense of shutting down the coal industry, in comparison to subsidizing the coal sector, requires economic analysis that first must be backed by reliable mine feasibility, market, and economic studies.

If the coal sector is unprofitable, the quantification, in economic terms, of the value of the Georgian coal sector to the national security must be established by cost-benefit analysis. The capability of Georgia to provide economic assistance must be analyzed so a decision about subsidizing the Georgian coal industry can be made as soon as possible and can be effectively implemented. This analysis would determine if tax incentives would be adequate or whether direct subsidy is necessary. The information provided in this report is intended to provide solid understanding, from a third party perspective, of the economic potential of the Georgian coal sector as a means to initiate rational future decision making.

CHAPTER 1
COAL RESOURCES

Coal, upon initial identification as a coal deposit, are often termed coal resources until further evaluation can establish the form, extent, volume, discontinuities, mining feasibility, quality parameters, market, transportation, and economic variables. In western terms, when coal resource characteristics have been established, determined to be desirable by markets, and can be expected to be profitable they are deemed to be coal reserves and constitute a coal reserve base. Note the distinction between resources and reserves. It is important to understand that coal reserves are time dependent because they are dependent upon economic, technologic, and market forces. This chapter initially defines the coals of Georgia as coal resources and then compares these resources to western standards as a measure to define whether they are resources or reserves, as determined by western standards.

1.1 COAL RESOURCES OF GEORGIA

1.1.1 Coal Resource Volume

Uneconomic coal resources of Georgia include the Megana and Gelati coal deposits located along the southern hillsides of the Caucasus mountain range. Defined economic coal resources in Georgia are confined to three areas; the Akhaltsikhe, Tkvarcheli, and the Tkibuli-Shaori coal deposits, of which the Tkibuli-Shaori coal deposits contain most of coal resources. Total coal resources at Akhaltsikhe and Tkvarcheli are 75 and 22 million tonnes, respectively.

For reasons stated in the introduction, this report only addresses the Tkibuli-Shaori coal deposits. The Tkibuli-Shaori coal deposits are located 40 kilometers north-northeast of Kutaisi. Kutaisi is located about 250 kilometers west-northwest of Tbilisi. The coal field has been defined by surface drilling as well as mine development workings. Coal samples have been obtained and analyzed for quantitative and qualitative parameters to predict the quantity and quality of coal that can be produced. In addition, results from mining operations provide a lengthy record of production capability upon which coal resource value can be defined. This production history is important in that it increases the degree of reliability in correlating surface drilling information to expectations of coal resource availability and the quality of mining products.

Geologic formations containing coal at Tkibuli are members from the Jurassic and Tertiary geologic time periods. The combined thickness of coal seams in the coal measures varies from

16.8 to 32.8 meters. These coal measures include up to 6 individual coal seams that vary in thickness and lateral extent. The thickness, in meters, of the individual coal seams are shown below in Table 1-1 from shallowest to deepest:

Table 1-1

Coal Seam Naming Convention and Seam Thickness

#	Coal Seam Name	Coal Thickness – meters	Typical Interburden* Thickness – meters
1	II	2.3 - 2.4	--
2	7/4	2.1 - 3.6	1.1
3	III	2.5 - 6.9	2.8
4	IV	2.4 - 10.4	3.4
5	V	Approx. 3.5	3.4
6	VI	Approx. 2.4	1.4

* Interburden refers to the unit of geologic material between the seams (above referenced seam) that are of non-coal nature. The data here is based upon cross-sections from the current mine plan areas to provide a representation and may not correspond to the entire coal field.

Coal resources at the Tkibuli-Shaori coal deposit are estimated at 382.2 million tonnes while the reserves are generally stated as 332.4 million tonnes. It has been calculated that about 25% of the coal resources have a coal seam thickness of 1 to 3.5 meters thick, 35% have a thickness between 3.5 and 6.5 meters, and 40% have a thickness between 6.5 and 10.4 meters. The coal resources formally accepted by the Georgia Mineral Resource State Commission and employed by JSC Saknakshiri for the Tkibuli-Shaori coal deposit are provided below in Table 1-2:

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Table 1-2

Tkibuli-Shaori Coal Resources

Millions of Tonnes

	Resource Category					
Resource Area	A	B	C1	A+B+C1	C2	A+B+C1+C2
Mindeli Mine	3.6	30.4	14.2	48.3	0.1	48.4
Imereti Mine	0.2	1.6	0.8	2.6	0	2.6
Western 2 Mine	0	27.9	12.4	40.3	0	40.3
Subtotal Active	3.8	60.0	27.4	91.2	0.1	91.3
Western Mine	0	2.8	3.6	6.4	0	6.4
Tsoulikidze Mine	0	0	0.5	0.5	0	0.5
Subtotal Closure	0	2.8	4.1	6.9	0	6.9
New Shaori Mine	0	25.8	42.3	69.1	48.5	116.6
Central Shaori	0	56.7	70.8	127.5	0.3	127.8
Other Districts	0	8.7	30.0	38.7	0.9	39.6
Subtotal Inactive	0	91.2	143.1	234.3	49.7	284.0
Grand Total	3.8	154.0	174.6	332.4	49.8	382.2

The coal quantities above are termed as coal resources in the text to allow definition of coal resource categories later in this text, as mentioned earlier. We have defined the resources above, in the left-hand column, by type of mining relative to these resources. The most important classification is the subtotal active group because these resources would be mined by mining activities envisioned in the near term and total 91.3 million tonnes. The resources grouped as subtotal closure, 6.9 million tonnes, are resources connected to past mining activities that should be closed down and abandoned. The last category of resources is the subtotal inactive group with 284.0 million tonnes and references resources that are beyond the regions of the areas assigned to each of the individual mining areas referenced in the active and in-active mine classifications. These resources could potentially be mined in the future if it were economic to do so at that point in time.

1.1.2 Coal Quality

The quality of the coal at Tkibuli is determined by Russian Gos Standards. These standards are very similar to American Standards for Testing and Materials, ASTM, British Standards BSI,

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and Organization for International Standards, ISO. The results of the sampling and analysis can therefore be analyzed on a comparable basis but expert knowledge is required. The results of the coal testing for the Tkibuli field are shown below in Table 1-3.

Table 1-3

Coal Reserve Quality Characteristics of Tkibuli-Shaori Coal Field

Characteristic	Statistical Results	Units
Run of Mine Size Fraction	0 to 200	Millimeters
Proximate Analysis		
Average Ash Content	33.0	%
Maximum Ash Content	36.5	%
Moisture Content	13.5	%
Sulfur Content	0.5 to 1.5	%
Volatile Matter Content (dry ash free, DAF, basis)	41.5	%
Minimum Working Heat Capacity	4,400 to 4,700	Kcal/kg
Maximum Working Heat Capacity (dry ash free, DAF, basis)	7,200 to 7,500	Kcal/kg
Ultimate Analysis		
Carbon	78.7	%
Hydrogen	5.5	%
Nitrogen and Oxygen	1.4	%
Unmeasured Elements	14.4	%
Mineral Ash Analysis		
Ferric Oxide (Fe_2O_3)	6.7	%
Aluminum Oxide (Al_2O_3)	34.6	%
Silicon Dioxide (SiO_2)	51.6	%
Calcium Oxide (CaO)	1.4	%
Magnesium Oxide (MgO)	0.8	%
Sulfur Trioxide (SO_3)	0.8	%
Undetermined	4.1	%

The maximum working heat capacity shows the high calorific value, 7,200 to 7,500 kcal/kg of the coal without the moisture and ash constituents in the coal. When the ash and moisture constituents in the coal are included the minimum working heat capacity shows a 4,400 to 4,700 kcal/kg character, which is quite low. The coal also exhibits a reasonable sulfur range of 0.5 to 1.5 %, reasonable moisture content of 13.5%, high volatile matter content of 41.5%, moisture and ash free basis, high carbon content of 78.7%, and a very high ash content of 33%.

1.1.3 Coal Hardness

Coal hardness is measured by tests employing a rolling steel ball within a race which may be comparable to the method used by ASTM grindability testing, the Hardgrove Grindability Index. The Hardgrove Grindability Index ranges from 30 to 110 units, with an index of 30 being very hard to crush and an index of 110 being very easy to crush. The Georgian (FSU) method assigns a hardness index ranging from 0.85 to 1.00 units, on a straight-line scale, for black or stone coals. An index of 0.85 is easy to crush while an index of 1.00 is very hard and difficult to crush. The FSU index average for the coal seams at Tkibuli is 0.90 and therefore places it in the lower third range and defines this material as a fairly easy to crush. The likely Hardgrove Grindability Index for this coal is about 55 units.

The coal is said to be very easy to crush and is susceptible to friability upon mining and handling operations. Immature coal seams that are located as waste between the mature coal seams are said to be much harder and difficult to crush. When this material is included as a dilution material in the coal product, it requires a noticeable increase in the crushing power. About 7% of the materials produced from the mine are reputed to be hard to crush.

1.1.4 Coal Bed Methane

The coal seams in the Tkibuli deposit contain appreciable amounts of coal bed methane. The methane has been measured and is said to range from 15 - 20 cubic meters per tonne in mine-workings areas to 45 - 50 cubic meters per tonne in the central part of the reserve. Coal bed methane extraction from underground coal reserves is a proven technology and quite worthy of consideration for economic development opportunity. Ventilation is employed in the mine to provide fresh air for workers and remove coal bed methane from underground workings.

1.2 GEORGIAN STANDARDS COAL RESOURCE DEFINITION

According to Georgia State Geology Department criteria, Classification of Solid Fossil Mining Resources and Prognosis Resources[1], coal resources are classified according to Former Soviet Union Gos Standards. These standards dictate that coal resources be classified into two groups as shown in Table 1-4. The first group, Resources, includes four categories A, B, C1, and C2 and references exploration and exploitation activities to define the resource. The second group, Prognosis Resources, includes three categories, P1, P2 and P3 and references resources with the possibility of new mineral body exploration. These categories are assigned to coal resources

[1] Useful Mineral Resource State Interministerial Commission under the State Geology Department; Classification of Solid Fossil Mining Resources and Prognosis Resources, 13p. See Appendix A

dependent on coal deposit researchable quality and economic values. In the case of the Tkibuli-Shaori coal deposit we only need to be concerned with the Resource categories A, B, C1, and C2, because we are only concerned with economic reserves.

The A, B, C1, and C2 coal resources are further categorized as balanced and unbalanced dependent upon their economic importance. These are defined below:

Balanced Resources:

a) "Resources that are competent enough in the market, are economically efficient and fulfill the usage and environment protection requirements."

b) "Resources that are not competent and economically efficient but the extraction of which is made possible by support from the government's side by subsidies, tax cuts, and so on."

Non-Balanced Resources:

a) "Resources that comply with the requirement set forth toward the balancing resources but the usage which is not possible due to mining-technical, legislative, ecological and other aspects."

b) "Resources, extraction of which is not recommended due to low consistency of useful components, low capacity or difficult production features but usage of which is feasible for the nearest future. The economic efficiency will be raised on account of increase in the prices or technological break-through that will decrease production costs."

Table 1-4

Classification of Useful Solid Mineral Resources and Prognosis Resources in the Former Soviet Union, 1981

Economic-Environmental Classification	Resources		Prognosis Resources		
	Explored Resources	Pre-evaluated Resources			
Balanced	A+B+C1				
Non-Balanced	A+B+C1	C2	P1	P2	P3

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The guidelines for these definitions are established by rules promulgated by the Georgia Useful Mineral Resource State Interministerial Commission. In Georgian terms, the definition of resources is dependent upon criteria determined during the mine planning or preparation process when it is necessary to set limited quality requirements for the extractable resources. Resources are measured and traced and prognosis resources are evaluated according to mineral resource consistency in the earth and the perspective of their potential industrial utilization. The resources are categorized as reserves by sub-classification as shown below in Table 1-5.

Table 1-5 presents a strict interpretation of the guidelines provided by the State Geology Department. The guidelines do not present a clear and concise set of rules wherein it is quite obvious to us what conditions are established for each set of classifications. For example, rather than employing the same language for each classification criterion, the definition changes from determined to studied, evaluated, or principles determined. The definition of each of these characteristics is not provided. Therefore, it is up to the coal professional and the Commission to determine how the standards fit the coal resource. The classifications shown in Table 1-5 therefore are our interpretations, given limited investigation, to demonstrate reserve classification criteria as much as the guidelines allow. Because mineral and metal deposits vary so widely, it is often difficult to develop standards that are directly applicable to every deposit. Therefore, some license for interpretation is often necessary.

Table 1-5

Georgian General Criteria for Classification of Coal Resources

Resource Category Criteria	A	B	C1	C2
Useful resource size determined	Y	Y	Y	N
Useful resource form determined	Y	Y	Y	N
Useful resource layers determined	Y	N	N	N
Morphology studied	Y	N	N	N
Principle of internal structural alteration studied	Y	Y	Y	N
Principle of internal non-conditional areas studied	Y	Y	N	N
Fault amplitudes calculated	Y	Y	N	N
Natural varieties determined	Y	Y	Y	N
Industrial resource types and qualities determined	Y	N	N	N
Resource consistency determined	Y	N	N	N
Resource characteristics determined	Y	N	N	N
Forms of harmful and utilitarian components in minerals studied	Y	Y	N	N
Patterns of harmful and utilitarian components in minerals studied	Y	N	N	N
Contours of useful mineral resources determined in accordance with conditional requirements	Y	N	N	N

Note: Y = Yes, N = No

Mineral deposits are also classified by the complexity of the geologic structure according to Georgian standards. The 1st group has simple geologic structural integrity, the 2nd group has complicated geologic structural integrity, the 3rd group has extremely complicated geologic structural integrity, and the 4th group has exceptionally small deposits in extremely complicated geologic integrity. This classification is shown below in Table 1-6.

Table 1-6

Division of Resources Dependent on Geologic Structure

Group	Description	Allowable Classes
1	Simple Geologic Structure	A,B,C1,C2,P1
2	Complex Geologic Structure	B,C1,C2,P1
3	Extremely Complex Geologic Structure	C1,C2,P1
4	Exceptionally small sized Deposits With Extremely Complex Geologic Structure	C1,C2,P1

Resources classified as justifiable to support investment activities include A, B, and C1 categories with the stipulation that for complex deposits, C1 coal resources could not exceed A plus B coal resources. According to Sakgeologia, additional criteria for including coal in the reserve classification is that coal reserve seams must have a minimum thickness of one meter and have an in-situ maximum ash content of less than 45%. Coal reserves at the Tkibuli-Shaori coal deposit are stated at 332.4 million tonnes, as shown in Table 1-2. The State Commission of the Former Soviet Union has confirmed 218.3 million tonnes of this coal quantity.

1.3 INTERNATIONAL STANDARDS COAL RESOURCE DEFINITION

Coal resource standards are developed to establish methodologies whereby coal reserves can be classified in a uniform manner such that coal reserves can be understood and compared in a meaningful way. There is not one standard that is applicable throughout the world. Some widespread standardized systems used throughout the world include:

United States Geological Survey, USGS, System

United Nations Economic and Social Council International Classification System

Bureau of Mineral Resources, Geology and Geophysics of Australia Classification of Mineral Resources System

Classification of Useful Solid Mineral Resources and Prognosis Resources of the Former Soviet Union, FSU

These systems follow roughly the same principles of logic but do have notable differences. In this report, we will analyze the Georgian classification system by comparing the FSU system to the American USGS system. The Georgian classification system is identical to the system used within the FSU and therefore is quite appropriate in the comparison. The USGS system covers a broad range of coals and includes a vast quantity of resources that have been used to establish a reliable system that incorporates proven economic principles.

The USGS system provides guidelines for classifying coals into identified and undiscovered resources. These categories are then further sub-categorized. Identified resources are categorized into demonstrated, which is further categorized into measured and indicated, and inferred resources. Undiscovered resources are categorized into hypothetical and speculative resources. Once these reserves have been classified within these groups, the groups are further segregated into economic categories. This classification system is shown graphically in table 1-7.

Table 1-7

USGS Principles of Classification of Mineral Resources and Reserves

Economic Category	Identified Resources			Undiscovered Resources	
	Demonstrated		Inferred	Hypothetical (Predicted)	Speculative
	Measured	Indicated			
Economic					
Marginally Economic					
Sub-economic					
Other Occurrences					

This classification system is reliable because it first classifies the coal resource upon how well the resource is identified for technologic considerations such as coal quantity, quality, geologic conditions, geotechnical conditions, hydrologic condition, environmental conditions, definition for marketability, and so forth. The system is even more important because it then further categorizes the resource, assuming current market and economic conditions, to ascertain where

the resources belong within each reserve definition technologic category. Because economic and market conditions change, it is necessary to re-evaluate coal resources on a periodic basis. This system allows the coal resources to be reclassified as economic condition changes. It is important to note that western practices usually rely upon demonstrated economic reserves when performing economic analysis and decisions.

1.4 GEORGIAN COAL RESOURCES DEFINED ON AND INTERNATIONAL BASIS

It is necessary to correlate the classification system used for Georgian coals to coals resources classified with an international system. Once this correlation is made a more precise understanding of the coal reserves, stated in Georgian terms, can be made by the financial community or others interested in the Georgian coal sector. For reasons stated above, this comparison is made to the USGS classification system shown in Table 1-7.

Primarily, the classifications used by the Georgian (FSU) system can be roughly compared to the system used by the USGS except for the economic considerations. The measured category in the USGS system equates to the A+B categories, the indicated class relates to the C1 class, the inferred to the C2 and P1 classes, and the hypothetical and speculative classes refer to the P2 and P3 classes, respectively. This is shown graphically below in Table 1-8.

Table 1-8

Comparison of Georgian and USGS Reserve Classification Systems

Economic Category	Identified Resources			Undiscovered Resources	
	Demonstrated		Inferred	Hypothetical	Speculative
	Measured	Indicated		(Predicted)	
	{A+B}	{C1}	{C2, P1}	{P2}	{P3}

This Georgian system of classifying reserves according the level of knowledge about the resource can be understood to be roughly equivalent to the USGS classification system. This comparison can also be broadly equated to the FSU economic concept of balanced and non-balanced resources and the four economic categories of the USGS system. Extreme caution must be employed when this comparison is made because of the underlying assumptions to establish economic viability. The FSU system, because it was based on central government planning concepts, employs a condition that the reserve could be classified as balanced (or economic) if government subsidies are considered. Because government subsidies could be quite substantial and also because prices were state controlled, one must be careful when analyzing economic coal reserves. This condition is a normal precaution taken by a prudent analyst and often requires intimate knowledge of the resources, mining operations, plans, economics, marketing, taxation, governmental support, and resultant feasibility studies.

Because this is a complex issue, it may be of value to see what advice the USGS offers on this subject. In the report Assessment of the Coal Resources of the Kyrgyz Republic[2], USGS authors concluded:

> *"In the former Soviet Union (FSU) system, the term "resources" is rarely used, and only in the sense of total geological resources. Usually, the term "reserves" is used, with modifiers, throughout the classification system, and "(total) geological reserves" is roughly resources in the USA system. Reserves in the western sense are dependent on the price of coal. In contrast, in the FSU classification system, the concepts of coal "price" and "value" are not as important and the term "reserves" may not imply economic recoverability today. The FSU term "reserves" (zapasy) does not necessarily mean that the market price of the coal equals or exceeds the cost of mining it, though "balance reserves" has somewhat that meaning."*

Appendix B provides a more in-depth comparison for several coal resource classification systems used around the world today that was provided by Dr. Tamaz V. Janelidze and Mr. Michael Johanalidze, of the Georgia State Department of Geology.

1.5 ECONOMIC COAL RESERVES

Based on the discussion above we can draw some pertinent conclusions:

1. The Georgian classification system is well founded to establish categories of coal resource based upon how well the coal deposits are defined. Therefore, this should

[2] Assessment of the Coal Resources of the Kyrgyz Republic, USGS Open File Report 97-137A, by E.R. Landis, N.H. Bostick, H.J. Gluskoter, C.D. Harrison, D.W. Huber, and E.A. Johnson; 1996.

increase the reviewer's confidence that coal resources do exist as scientifically summarized.

2. The balanced and non-balanced categories can provide some idea of the economic potential of the mines. More in-depth analysis of recent feasibility studies and the relationship between those studies and coal resources which could be mined economically should be conducted by qualified mining experts in order to fully understand what reserves are truly economic.

The coal resources stated in section 1.1.1 of this report were categorized in order to segregate coal resources included in mines to be closed down and resources applicable to other future mines from our consideration as economic coal reserves. We will therefore only focus on the coal reserves relative to the mines that are planned for near-term future production. These mines include the Mindeli, Imereti, and the Western 2 production facilities. The coal resource information for these mines is reproduced below in Table 1-9 and, based on the Georgian (FSU) classification system and our analysis, is classified as coal reserves, rather than coal resources.

Table 1-9

Tkibuli-Shaori Near-Term Mineable Coal Reserves

Millions of Tonnes

	Resource Category					
Resource Area	A	B	C1	A+B+C1	C2	A+B+C1+C2
Mindeli Mine	3.6	30.4	14.2	48.3	0.1	48.4
Imereti Mine	0.2	1.6	0.8	2.6	0.0	2.6
Western 2 Mine	0.0	27.9	12.4	40.3	0.0	40.3
Subtotal Active	3.8	60.0	27.4	91.2	0.1	91.3

In the west, it is generally considered a safe decision to base mine economic study and financing upon measured and indicated reserves of the USGS system. This would be comparable to A + B + C1 reserves of the Georgian classification system. Additional risk can be determined by analyzing the percentage of reserves that fall within each of these classifications.

The Georgian classification system shows that essentially all the reserves related to these mines are classified as measured and indicated reserves. We can therefore equate that it is possible that

91 million tonnes of reserve fall within these categories. Nonetheless, there are some other considerations that are not included within the figures shown in Table 1-9.

During exploitation of the coal reserves there are natural losses which are due to geologic and other non-mining issues. Tkibuli mine management indicates that the assumption employed by their professionals is 14%. In addition, there are losses which are resultant from mining operations which include coal left in barrier pillars, lost in poor structural areas, left in the roof and floor of coal seams, and during handling. Tkibuli mine management indicates their assumption for this loss ranges from 16 to 18%. The total reduction in reserves available for mining is therefore 32%, if we assume the maximum figures. The quantity of coal reserves, using Tkibuli mine management assumptions, which can be considered as marketable are shown below in Table 1-10.

Table 1-10

Maximum Coal Reserves Available for Market Sales

From Near-Term Production Mines

Resource Area	A+B+C1 Million Tonnes	Reductions Due to Geologic and Mining Loss Million Tonnes	Maximum Coal Reserves Available for Market Sales Million Tonnes
Mindeli Mine	48.3	15.5	32.8
Imereti Mine	2.6	0.8	1.8
Western 2 Mine	40.3	12.9	27.4
Subtotal Active	91.2	29.2	62.0

Therefore, it appears there could be approximately 62 million tonnes of coal available for market sales within the mining boundaries defined for these three mines. These three mines will work as a unit to develop these reserves, independent of the reserve classification shown above. Mine management indicates their latest mining plan works all three mines in to produce the coal required for market.

Assuming that all these reserves exist and can be sold at a reasonable profit, there are adequate reserves to last 89 years, assuming a 700,000 tonne per year mining rate. Unfortunately, we can not provide any further insight on the volume of coal reserves that are economic under current market conditions. This is due to the fact that quite a bit of effort is necessary to fully understand and value economic coal reserves. Before one values the coal reserves, it is necessary to fully understand market conditions, transportation issues and costs, market demand, and market prices. There is not adequate information to be able to complete this task at this point in time.

For the purposes of this report and our analysis, this work effort was not included in the scope of work.

We can conclude that, in our opinion, it is quite possible adequate reserves exist for the mining concepts envisioning the production of 700,000 tonnes per year for a period of 20 years. The envisioned mining concepts would require 14 million tonnes of saleable coal. This represents about 23% of the coal reserve within the defined mining boundaries. We can not conclude whether these coal reserves are economic because adequate information is not available and the effort is beyond our work scope. We can conclude that there definitely is potential for coal production operations.

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CHAPTER 2
MINE PRODUCTION ENVIRONMENT

2.1 TKIBULI MINE LOCATION

The Tkibuli coal deposit and mines are located within the Tkibuli governmental administrative region in western central Georgia. The Tkibuli-Shaori coal deposit is situated in the north part of the Nakerali Range, which bounds the Tkibuli-Shaori basin on three sides. The regional climate is mild and humid with an average annual precipitation of 1650 millimeters. The local rainfall ranges from 1430 to 1700 millimeters, dependent on ground elevation. The ground elevation in the immediate area ranges roughly from 600 to 1500 meters above sea level. The average annual temperature is 12.2° centigrade.

2.2 TKIBULI GEOLOGIC ENVIRONMENT

Georgian geologic professionals have determined the Tkibuli coal was formed during the Jurassic and Tertiary geologic time periods. The coal is contained within a syncline (or a handle-less spoon shaped object) with it major axis oriented to the northwest. The syncline has been subjected to major geologic structural forces that have caused major and minor faulting within the coal deposit. In a limited area in the southwest part of the deposit, the coal seams outcrop at the ground surface.

The tectonics transformed the coal deposit into a syncline with small folds and faulting as well as major faulting. The folding and faulting occurred in two major time periods: after the Jurassic and before the Cretaceous time periods. The dip at the top of the flanks of the syncline measure 40° to 50° (as measured down from horizontal) but then graduate down to a range of 0° to 10° in the bottom of the syncline where the depth from the ground surface is the greatest.

The coal deposit is crossed by the Sabilasuri fault which has an east to west strike and is pre-Cretaceous. This fault's amplitude is 450 meters with the southern side being down-thrown. This fault is nearly vertical and forms the border of the eastern and southeastern boundaries of the deposit. Another fault, the Makharauli, has a strike of southeast to northwest with an amplitude measuring 750 meters. The throw decreases, in a scissors-type fashion to zero as the fault continues to the northwest. The dip of the fault is to the northeast ranging from 50° to 70° with the northeast side of the fault being down-thrown. In addition to these major faults, there are numerous minor faults with amplitudes ranging from 10 to 15 centimeters. These faults decrease in number as the depth from ground surface increases. These faults generally lie parallel to the Makharauli fault and also have their northeast sides down-thrown.

The Jurassic deposits contain no water. There are occurrences of water in the limestone above and ground surface loam deposits. This is important as it means the mine does not have to be de-watered, especially if mining operations have ceased.

2.3 MINE PLANNING

The mine plans developed for the Tkibuli mining complex have been prepared by JSC Tkibulnakshiri management, engineers, and planners in cooperation with Saknakshiri, the state coal mining company. Plans have recently been developed to determine mining costs for production of 700,000 tonnes per year. The coal production build-up period begins in year 2000 and ends in year 2006 to prepare, primarily, for coal supply to a 125 MW coal-fired power station envisioned to be constructed near the mine. During this period, coal production will grow from 50,000 to 700,000 tonnes per year. Construction of the power plant is expected to be complete with commercial operations commencing on March 3, 2003.

The production build-up period assumes sales of coal products to other unidentified customers during this time. This build-up coal sales volume represents a decision by management to evaluate mine economic results at several production levels before the target 700,000 tonnes per year is achieved. The build up schedule does not reference specific coal markets. The mine economics therefore are impacted by the build-up schedule and need to be re-planned to recognize coal markets as well as minimum mine construction requirements. Modern computers and mining software do not exist and all work is performed by hand. Even the summarization of mine economics is performed by hand so it is a time consuming and arduous task to prepare a mining economic study. JSC Tkibulnakshiri and Saknakshiri therefore do not have the luxury of in-depth economic evaluation and mine plan assessment.

Mine planning assumes the maximum production from an underground mine is 500,000 tonnes per year. Therefore, in order to achieve production of 700,000 tonnes per year, two mines, the Mindeli and the Imereti are necessary. A third mine, the Western 2, is included in the plan as an extension of the Imereti mine. The Imereti and Western 2 mines can apparently be worked together in unison to reduce overall costs. All three of these mines will extract coal from adjacent coal areas within the same coal deposit. The individual mines are presumed necessary to access the coal seams in a manner designed to optimize coal resources and reduce operating and capital costs. Production limitations are imposed by criteria such as the need for a minimum number of coal production faces, men and materials ingress and egress, development operations, safe working conditions, coal transportation and ventilation. In the general plan, the Imereti mine is designed to mine the upper levels while the Mindeli mine is established to mine the deeper mine levels.

Our review of materials concerning mine planning has been limited by scope of work such that we are unable to comment upon the quality of the effort to develop the mine plan. We assume the work is professional and properly conducted. We do see the lack of computers and mine

planning software is a serious impediment to the ability of mine management to quickly and easily assess alternate mining concepts and plans. Subsequently, we are unable to address issues about the degree of success mine management has had in optimizing mining concepts, plans, and economics. We have observed information that presents alternative near-term development concepts for the Tkibuli-Shaori deposit. These alternative concepts have obviously been evaluated to select the best alternative of the options presented. In another step of optimization, management has reduced capital costs in order to make the mining economics attractive and more acceptable to potential investors. It can therefore be assumed that the mine plan is optimized, to some degree.

From our review, the techniques involved in generating the mine plan and economics employ a professional approach and attention to detail and are yet typical of methods used in the FSU region. Costs are based upon mining methods that have been employed in the past and assume the use of Russian, Ukrainian, or regionally produced equipment. It is quite possible the employment of more mechanized mining methods and western equipment could result in higher productivity and lower costs. Because of Georgian professionals' regional isolation, it may be of value for Saknakshiri/Tkibulnakshiri mining experts to review methods employed in mines operating under similar mining conditions elsewhere in the world.

If potential markets seem apparent, we recommend that an independent review of the mining concepts and economics be conducted to establish if mining productivity can be improved substantially and that local mining experts' vision of foreign mining methods be enhanced.

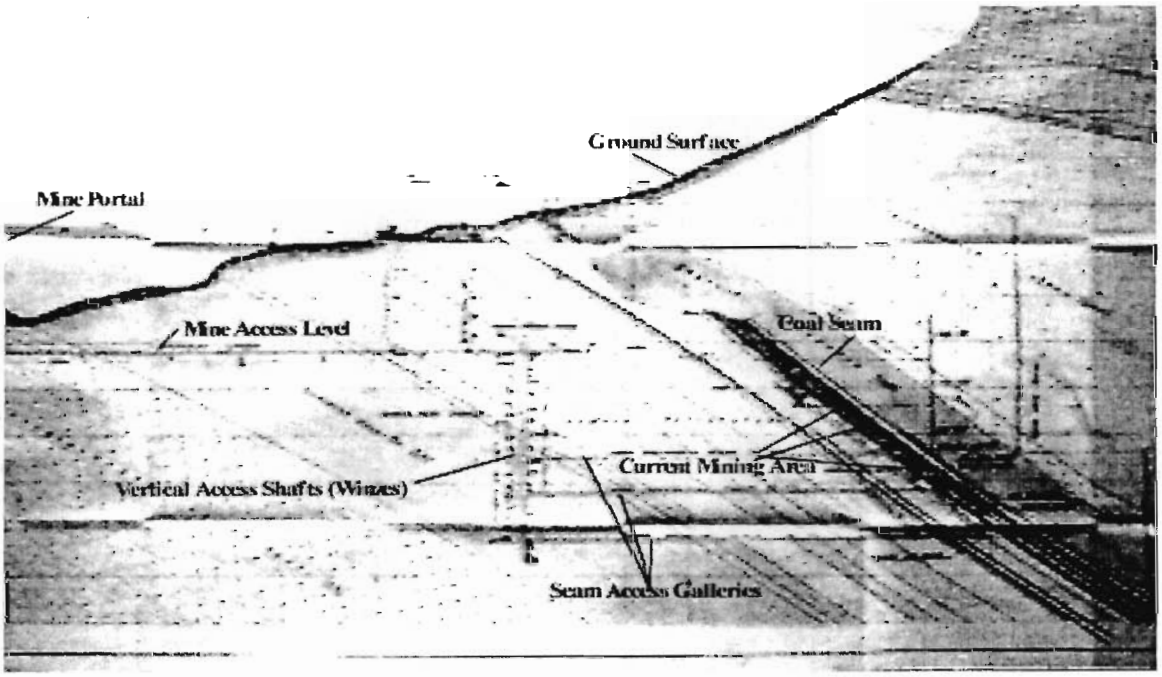
2.4 MINE PRODUCTION

Mining at the Tkibuli-Shaori coal deposit is executed by underground mine methods. The coal reserves dip down at such angles that the coal quickly becomes unrecoverable by surface mine methods. The coal seams partially outcrop to the surface in a region located below a massive limestone morphological structure in the form of the Nakerali range. Regionally, the absolute height of the range above the basin area ranges up to 1,500 meters. As the coal dips under the range, the depths of mining increase from a few hundred meters to over 1,700 meters. Access to coal seams, however, is provided by adits (tunnels) which are about 3 kilometers in length, driven horizontally from the surface to the coal seams. After shallower coal deposits had been depleted, winzes (vertical mine openings) were driven underground from the adits to gain access to deeper coal deposits. Access galleries (tunnels) were then driven to the coal seams. These workings are shown in Graphic 2-1.

Coal extraction now occurs between the 240 and 400-meter levels (above sea level). The depth of mining is, therefore, about 180 to 340 meters below the adit access that is located at the 580-meter level. As mining operations extend underneath the Nakerali range in pursuit of coal reserves, the thickness of earth cover over the coal seams increases. Although mining operations

are only conducted a maximum of 340 meters below the mine access level, the thickness of earth above this level is approximately 900 to 1100 meters. This is important for three reasons. First, the mine access scheme prevents all men, materials, waste rock, and coal moved in and out of the mine from being vertically hoisted completely to the surface. Secondly, as the thickness of geologic materials over the coal seam increases, the increased weight upon mine openings increases mining costs. Third, as mining progresses down-slope in pursuit of the coal seam, mine haulage and development costs also increase.

Graphic 2-1



Cross Section of the Mining Area of the Tkibuli Mines Complex

The mining method employed at Tkibuli is rather unique within the world. Most unique is that a very thick section of coal is being mined by underground methods. The total coal thickness within the mining section ranges from 17 to 33 meters and most of this coal is won during mining operations. As can be seen in chapter 1, there are up to six coal seams that are separated by non-coal members. These non-coal members have a thickness ranging from 1 to 3 meters. Normally, 3 to 4 seams can be won but the non-coal members between the coal seams is generally quite thicker and the coal is not won with caving methods. The mining methods employed at Tkibuli maximize the coal resource by mining each of these seams, one at a time

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from the top down, as long as they are of adequate quality. In comparison to most modern mines, little of the coal extraction process is mechanized. Much of the coal extraction work is performed by manual labor.

Coal recovery from mineable reserves was said by mine management to be about 86%. This coal recovery efficiency is extremely high for the mining conditions encountered. Most often, even in single seam mines, an extraction ratio of 80% is considered an extremely high figure. In poorly performing surface mines, recovery factors such as those quoted for Tkibuli are often experienced! This extraction ratio is very important because it is directly related to overall mine economics. Higher extraction ratios reduce overall mining costs on a unit-cost basis. At the same time, it is necessary to optimize the recovery ratio by relating recovery-rates to production costs.

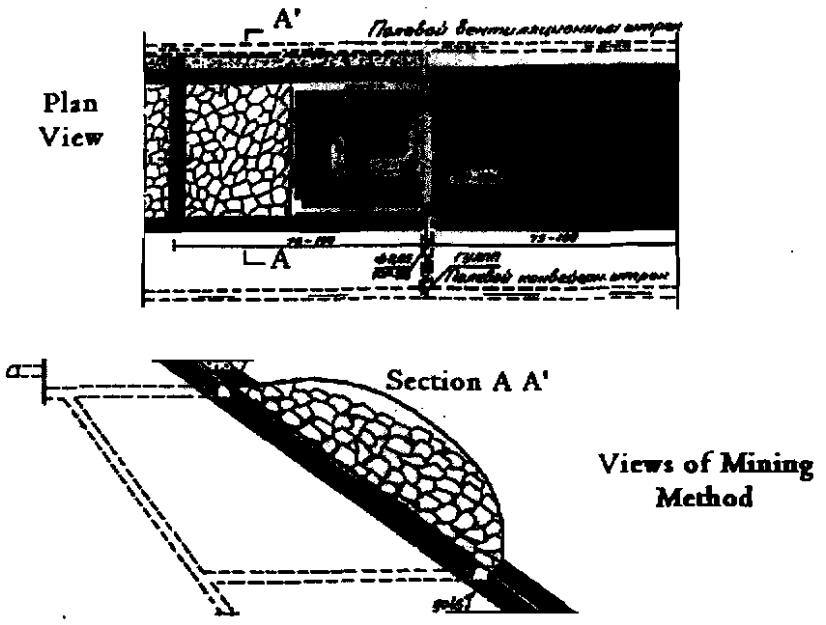
There are three dominant coal reserve characteristics at Tkibuli which drive the selection of the mining method. These characteristics are the dip of the coal seam, the massive thickness of the coal section, and the amount of overburden over the coal seams. In the area currently being mined, seam dips range from 30 to 40°. This is important because rubber tired equipment is only effective working on slopes less than 5 or 6° while track equipment can only work on slopes up to 15°. Often, mining methods cut across the dip to reduce the dip angle and allow the usage of rubber tired or track equipment. Because the dip of the coal seams exceeds 25%, gravity can also be employed by mining methods to win the coal. Our assessment did not include a detailed analysis of the mining methods because of scope of work considerations.

The massive thickness of the coal seams, the amount of overburden over the coal seams, and the degree of recovery planned requires removal of coal seams by methods which induce caving of overlying rocks into previously mined-out sections. Extraction of the coal seams must take place from top to bottom of the coal-bearing section. Immediately after the coal has been removed from the seam extensive roof support is employed with timber spaced throughout the mine opening in the coal seam. After the coal has been extracted, the roof overlying the mined-out coal seam is forced to cave to the floor of the mined-out coal seam. This act reduces the induced rock stress so coal seams underneath the mined-out coal seam can then be extracted. The floor of the mined-out coal seam then becomes the roof of the seam to be mined below. Because of the multiple number of seams which can be mined, this process is repeated for each seam until all coal is extracted in the vertical section. After this process is complete, mining then continues on a new vertical section down the dip from the vertical section just completed.

Access to the coal is developed through access galleries (tunnels) driven from the supply and coal hoisting winzes (vertical mine openings) to the coal seams. These galleries are spaced vertically every 50 meters and connect to gangways (tunnels) driven in the foot-wall parallel to the strike of the seam which are then connected by cross headings driven perpendicular to the strike and into the seams. This series of underground mine openings provides access at the top and the bottom and along the length of the coal seam vertical section to be extracted. The seam accesses can be seen in Graphic 2-2.

Mining employs the use of a breast and pillar type of method coupled with a caving method. This mining method is displayed in Graphic 2-2. Mining, which is advancing down the dip of the seam, is represented from left to right in the upper portion and down the seam in the lower half of the drawing. The dashed lines represent mine openings, the black areas represent coal, and the rubble areas represent the caved mining areas.

Graphic 2-2



Each block of coal removed ranges from 50 to 80 meters in width and from 75 to 100 meters in length. After this block of the coal is removed, the coal roof is allowed to cave, as shown in the bottom portion of the drawing. Once this operation on this seam is complete, mining will advance to the next seam, where another 50 to 80 by 75 to 100 meter block of coal directly under the mined-out seam (see the lower portion of the drawing) will be mined.

Several mining blocks (extraction faces) will be operating at one time to ensure production target volumes are met. Coal excavation is initiated by drilling holes in the face of the coal and blasting it with explosives. After blasting, coal is transported to a conveyor loading station by the use of gravity. Long pans are placed on the floor of the seam upon which the coal, loaded by hand, slides down to a conveyor loading station. From the conveyor loading station, coal is transported to the hoist loading-pocket at the winze by conveyor. Coal is then hoisted to the primary access adits where it is transported by rail to the surface and prepared for market.

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There are other systems that must be considered during mine design and operations. These include the transport of manpower, materials, and supplies in and out of the mine. In addition, fresh air is supplied throughout the mine. In a somewhat unique system, clay and water slurry is pumped into the caved out areas to combat spontaneous combustion of refuse coal. Spontaneous combustion is a phenomenon often observed in the mining of coal. Once coal is broken and exposed to air, coal moisture within the coal mass begins to evaporate causing and exothermic reaction which heats the coal mass. When the rate of evaporation is high enough, the coal can catch fire creating undesirable noxious gasses and safety problems. To combat this problem at Tkibuli, a clay water solution is pumped into the caved area to help seal the oxygen supply to the broken coal pieces remaining in the caved area. Eliminating oxygen supply is a standard method of combating spontaneous combustion.

In the past, a longwall mining method (a concept that uses mechanized coal extraction, transport, roof support and roof caving) was attempted at Tkibuli. Longwall equipment from Ukraine was secured and installed in the mine. The efforts to mine coal with this equipment failed because the roof collapsed and forced abandonment of the equipment before it could be rescued. Subsequently, because of this past effort and the seam dips encountered, little mechanization has been employed to extract coal.

2.5 COAL QUALITY AND BENEFICIATION

The coal product is similar to the quality of the coal deposit as noted in chapter 1. Upon mining, extraneous non-coal rocks are introduced into the coal product such that the coal is diluted by about 3%. This is a normal occurrence. The quality of as-mined coal during 1999 is shown below in Table 2-1. The heating value, or calorific value, is rather low in contrast to coals often observed in the international coal market. Coals competing well on the international market will often have a calorific content ranging from 6,300 to 7,200 kilo calories per kilogram, kcal/kg. The sulfur in the coal is a little high but is acceptable on the international market.

The low calorific value of the coal is caused by the high content of ash in the coal. Ash in the range of 5 to 15% is normally seen in the international market whereas this coal shows a content exceeding 34%. Coal quality experts at Tkibuli indicate ash is naturally distributed within the coal seams and doesn't come from major integral partings (non-coal members within the coal seam) which could be removed by selective mining practices. In the past, using old technology, they have been able to remove unwanted ash from the coal through coal beneficiation methods.

The raw coal also has an appreciable amount of fines. Up to 50% of the run-of-mine coal has a size consistency of less than 20 mm with 35% less than 13 mm. Details of run-of-mine coal sizes are presented below in Table 2-2. The high quantity of coal in the smaller size fraction could possibly be due to the blasting procedure employed at Tkibuli.

It is recommended mine management consider a technique of undercutting the coal face with a coal saw prior to blasting in order to provide a second free face for coal expansion while the blast resonates through the coal face. This technique was successfully employed extensively throughout underground mines in the United States before the application of a more mechanized excavation method became the norm. This method may also reduce the quantity of explosives required while reducing the amount of fines produced.

Once coal is transported to the surface, it can be beneficiated, or cleaned of non-coal material. This has been done in the past at Tkibuli but is no longer performed because of the age and decrepit condition of equipment within the plant. Coal processing hasn't been conducted at Tkibuli since 1994. The conceptual design of the coal processing facility was not upgraded at any time and had not changed since the original construction in 1952.

Table 2-1

Average Coal Quality Characteristics of

Coal Production From the Mindeli Mine in 1999

Characteristic	Value	Units
Run of Mine Size Fraction	0 to 200	Millimeters
Proximate Analysis		
Average Ash Content	34.0	%
Maximum Ash Content	37.0	%
Moisture Content	13.5	%
Sulfur Content	1.2	%
Volatile Matter Content	39.5	%
Minimum Working Heat Capacity	4,200	Kcal/kg
Maximum Working Heat Capacity (daf)	7,200	Kcal/kg

Table 2-2

Approximate Size Fractions of Run-of-Mine Coal

Size of Coal Millimeters	Percentage of Feed Coal
0 to 13	35%
13 to 25	20%
25 to 50	20%
+ 50	25%

In the old plant, the as-mined (run-of-mine) coal was sorted by screen from a size range of 0 to 200 millimeters, mm, into100 to 200-mm and 0 to 100-mm size fractions. The +100-mm size fraction was transported to a hand-sorting operation where labor manually picked non-coal materials from the coal product. After this operation, the +100-mm coal size fraction was crushed to market specification and segregated for market sales. The minus 100-mm coal size fraction was segregated by screen into 0 to 13 mm, 13 to 25 mm, and 25 to 100 mm size fractions whereupon it was beneficiated by water jig. The characteristics of the coal products for the beneficiation process employed at Tkibuli are shown below in Table 2-3.

Table 2-3

Coal Beneficiation Characteristics for Tkibuli Coal

Specific Gravity Range	Weight Percent	Ash % (Dry)
Minus 1.4	15%	12%
1.4 to 1.8	65%	28%
Plus 1.8	20%	70%
Total	100%	34%

The yield for every tonne of feed was said to be about 75%. The results above show that an average ash of 25% could likely be produced with this older technology, assuming a 1.8 separation density. The potential impact of coal beneficiation is economically important to the Tkibuli mines. Because the methods to clean the coal at Tkibuli were quite dated and no work has been employed to evaluate western methods of coal beneficiation, it is questionable whether adequate assessment has been conducted on this topic.

The jig process to clean coal in Georgia is typical of the processes employed in Europe and the FSU during the 1950s and 1960s. Jigs, in contrast to other beneficiation processes, do not produce as sharp a separation and are not as efficient, do not clean very effectively down below 28 mesh (1/2 mm), and accept too wide a range of particle sizes, say 100 x 0 mm. In short, newer technologies such as dense media and cyclones may more appropriate for specific size fractions.

In discussions with professionals throughout Georgia, the impression given was that a coal beneficiation plant was likely too expensive from a capital cost perspective and the operating cost would be in the neighborhood of $8 to $10 dollars per tonne. In the United States, the general rules of thumb used to roughly estimate coal preparation costs employ a capital cost of $14,000 per tonne of hourly feed and an operating cost of around $2.00 to $3.00 per tonne of feed. Therefore, the cost for a beneficiation plant capable of handling 700,000 tonnes per year and operating 7,000 hours per year would be $1.4 million. This cost would have to be factored

for construction and operation in Georgia, but it provides a rough rule of thumb to employ until better information is available.

It is recommended that work be commenced to confirm the effectiveness of using western coal beneficiation techniques upon the run-of-mine Tkibuli coal product. This work should begin with discussions with western specialists and continue through with physical analysis, product prediction, and preliminary feasibility estimates, as necessary.

The decisions facing Tkibuli mine management affect the welfare of the economy in the immediate region. If the coal can be better beneficiated by technologies later than those employed in the 1950s, then this needs to be determined. It is deemed quite prudent to confirm whether coal quality can be improved by using modern methods before decisions about the marketability of Tkibuli coal can be considered properly conducted and complete.

2.6 MINE CLOSURE ISSUES

The two other mines that have been used for past production, the Western and Tsoulikidze mines now require closure and are a burden for JSC Tkibulnakshiri. Inadequate financial resources do not permit mine management to properly close these mines. JSC Tkibulnakshiri management indicates that it costs between $450,000 and $600,000 per year to maintain both mines. It is projected that $5 million is necessary to properly close the mines. Our review of these costs shows that they include social mitigation costs. The concepts and details of these costs were prepared by Saknakshiri and are provided below in Table 2-4.

A quick financial analysis shows that it is indeed economically desirable to close these two mines. If one assumes only the costs to shut down the mines and excludes the social costs (see Table 2-4), the cost estimate to shut down the mines would be $2.19 million. This capital expense would provide savings of $450,000 (the lower value of the estimated savings) per year. The internal rate of return over a 20-year period is 20%. Therefore, from an economic perspective, assuming an operating mine, the old mines should be shut down.

Regardless of future mining operations, the old mines should be shut down to conserve badly needed investment capital within the region. At the same time, a program to deal with the social issues caused by lack of employment needs to well thought out, funded, and implemented. The cost estimate in Table 2-4 addresses this task but a more comprehensive program is necessary to deal with the economic issues in the Tkibuli region.

It is obvious from the cost details in Table 2-4 that this closure plan constitutes a concept of restructuring the economy relying upon the Georgian coal sector. This effort is commendable because it focuses upon diversifying the economy within the Tkibuli region. This solution is very well conceived and should be implemented regardless of the future of the Tkibuli mines.

Table 2-4

Mine Closure Cost Table

Description of Expense Item	US dollars
Mine Closure and Related Impacts to New Mine Production	
Re-calculation of existing coal reserves on Tkibuli-Shaori field pursuant to new conditions	$50,000
Correction of the existing general scheme for mine development	$40,000
Additional Study of free and following air in the mine and determining its reserve	$300,000
Elaboration of liquidation project for two mines to be closed	$100,000
Carrying out mine liquidation works	$1,300,000
Final settlement with resigned personnel	$120,000
Settlement of budgetary and non-budgetary debts	$280,000
Subtotal	$2,190,000
Social Problem Mitigation	
Increase capacity for local timber refining	$200,000
Increase ebony production and refinement	$300,000
Equip a conservation plant	$250,000
Restoration of cattle breeding product industry and refinement enterprises	$450,000
Rehabilitation of bee farming	$150,000
Tea plant equipment	$220,000
Limestone exploration and production expansion	$400,000
Training of the resigned personnel for new employment	$80,000
Liquidation of depreciated enriching factory which endangers nearby residential area	$200,000
Management oversight to manage aforementioned activities	$400,000
Subtotal	$2,650,000
Grand Total	$4,840,000

We recommend that the closure concepts for the depleted Tkibuli mines be analyzed in detail to properly close these depleted resources from an operational, environmental, and social perspective. We further recommend that regardless of the hopes of future production from the Tkibuli mines, that a social program be implemented to begin solving the unemployment and economic problems currently being encountered by the inhabitants of the Tkibuli region. Funding should be provided to encourage remediation of social problems with solutions such as those proposed above. It appears prudent this program be managed on a local level to ensure funding is provided directly to the local economy and that restructuring of the local economy is supported by retraining and educational programs which work to assist the local residents to implement the changes to diversify their economy. This effort should also rely upon international sources that can provide oversight, advice, and resources to maximize the potential for successful economic rehabilitation.

The restructuring of the Georgian coal industry is already underway. By Presidential order the restructuring program consists of the following agendas:

1. Transfer of communal utilities on the balance of Saknakshiri (water pipelines, heating systems, etc.) and residential houses fund into the ownership of Tkibuli municipal management.

2. Separation of industrial infrastructure objects serving mines (auto-base, electro-mechanical plant, construction industrial factory, enterprise for material technical insurance, etc.) out of Tkibulnakshiri agglomeration as legal entities and their further privatization.

3. Allocation of the most prospective districts from Tkibuli-Shaori field and focusing attention on their restoration and development, liquidating and ecologically closing the most unworthy and non-prospective districts.

4. Change in the management of the Tkibulnakshiri agglomeration.

As a result of this presidential directive, city communal utilities and residential apartments owned by Tkibulnakshiri were transferred into the ownership of the municipality. Facilities purchased at the expense of Saknakshiri in Tbilisi, Kutaisi, and Akhaltsikhe were either transferred to the local municipalities or were privatized. Mine serving enterprises and separate limited liability companies were formed and their privatization is underway.

CHAPTER 3
MINING ECONOMICS

3.1 BUSINESS PLANNING

Saknakshiri has developed a business plan that includes a lengthy discussion of the issues relative to the business of producing coal from the Tkibuli mines. The plan was developed in 1996 with assistance from a European Commission TACIS program[1]. The document discusses and assesses the following items:

1. Background,
2. Proposed Future Activities,
3. Market and Rehabilitation,
4. Input Analysis (applied technology for coal production),
5. Operating Costs,
6. Planned Financial Calculations (economic analysis), and
7. Support and Impact of Government

The business plan provides much information of value and explains the concepts and philosophies behind the effort to redevelop the coal industry in Georgia. The technologic needs for the future development of the coal mine complex appear quite well developed and understood. The business plan employs proven methods and technologies that have been used for decades to produce coal from the Tkibuli mines. Several alternate mining concepts have been analyzed and a best case has been selected from the alternatives. Planned equipment is manufactured in the FSU because mining professionals in the region are familiar with this equipment. Curiosity about western equipment is expressed but alternatives to use western equipment and methodologies are not analyzed because of the lack of adequate information, experience and insight.

[1] Development of an Energy Policy in Georgia – Extension - Coal Sector Development Interim Business Plan, May 1996, Kantor management Consultants in Association with Dr. Professor Temuri Gochitashvili

In contrast, the market assessment, which is a primary ingredient in developing an acceptable economic analysis, is based on "preliminary marketing investigation". The potential that coal markets may provide, in terms of possible sales are discussed in general but little support exists as to specific markets which have been contracted, are planned to be contracted, or can be expected to be contracted in the future. In addition, issues such as discussion on market surveys, consumer descriptions, distribution networks, transportation costs, delivery costs, point-of-delivery issue discussions, likely contractual terms, market development, and market strategies do not exist.

This is due, in part, to the market disarray being experienced, but it is also very likely due to the limited experience Georgian professionals have had in developing new markets. In the past, a coal producer relied upon government, more or less, to define markets and market prices, and manage transportation issues and dictate costs. Now, external financing must be attracted so markets must now be adequately defined and strategies structured to develop markets. In our opinion, the coal market arguments put forward within the business plan will not convince potential investors that financing a Tkibuli mine venture is worth the risk involved.

In the future, we recommend the business plan be reformulated to define efforts necessary to achieve defined objectives. Specific objectives should be defined with goals, action plans, and execution completion dates that are based upon available resources. The business plan should consist of an explanation of the objectives defined by the company and efforts that will be expended to reach those objectives. Both short term and long term business plans need to be developed.

Capital and operating costs are developed and contrasted to market prices and sales volumes to generate an economic analysis. There is no support whatsoever to substantiate the market prices employed in the economic analysis. In order to gain the confidence of potential investors, a description of the targeted customers, coal sales volumes, market prices, and transportation costs must be presented such that the risk involved in the market side of the business can be better understood and evaluated. The coal volumes which are assumed to be sold to residential consumers, for example, estimate as much as 150,000 tonnes per year in sales but there is little support to show that this figure can be achieved or how the coal will be marketed and distributed. In addition, the marketing information shows size fractions of coal produced from a coal beneficiation facility yet details on the coal complex operation and costs do not reference the coal beneficiation facility. These issues cast serious doubt over the economic analysis presented in the business plan. In our opinion, a potential investor would immediately be concerned about the level of risk concerning sales of coal to the market. This conclusion is born out by the fact that markets have not developed and have not even been progressed as predicted in this business plan.

3.2 MARKET PLANNING

As mentioned above, it is our opinion that more focus should be placed upon the development and planning of future coal markets for the Tkibuli mining complex. Saknakshiri and Tkibulnakshiri envision the development of domestic coal markets for the consumption of Tkibuli coal. The market for Tkibuli coal is discussed and analyzed in chapter four. It appears to us that inadequate focus is being placed upon the marketing effort. For example, in discussions with Tkibulnakshiri management, inadequate information was known about specific coal markets, transportation specifics, and customer demand. Three persons were assigned to the marketing department. Because the primary problem being experienced is the lack of market, it simply does not make sense that only three individuals have been assigned to this task.

Given that the primary problem facing Tkibulnakshiri is the lack of market, it is recommended that much more emphasis be placed upon the marketing effort. It is our opinion that western style methods should be employed to assist in the development of an effective marketing department and training sought.

The creation of the working group by the President of Georgia, referenced in the introduction, is intended to initiate action on development of coal demand within Georgia. This approach to develop markets for coal products is quite necessary because generation of new markets requiring systems to burn coal for energy, heat or other purposes must be deemed appropriate and then purchased and installed. The cost effectiveness of purchasing and installing these systems must be properly evaluated and compared to other fuel alternatives. The distribution costs of the alternative fuels and desires of potential consumers must be considered. It is necessary to ensure that the overall national energy strategy employed produces results that are good for the economy, the environment, and national security. The goal of this effort should not be only to develop markets for the Tkibuli mine complex. Any investment should be based on solid economics that provide the best overall solution for the country, the economy, and its citizens.

3.3 MINING ECONOMIC PLAN

We reviewed the economic plan for the Tkibuli mine complex in sufficient detail to generate an opinion on this plan. Overall, the economics presented that represent the mining costs of the Tkibuli mines appear to be professionally prepared. Although the scope of our work did not allow in-depth evaluation of mining concepts and economics, we were able to generate an understanding of mine economics and conduct an economic analysis of the mining operations.

The mining plan has been developed to generate an operating plan and economic analysis by defining the locations where mining and development activities must take place to produce coal to meet market demand. Refurbishment of the Tkibuli mining complex has been planned to define mine reconstruction, new equipment, and mine development requirements. Manpower

required to produce coal and manage the operation are planned and also estimated. Mining costs are then estimated based upon productivity expectations, equipment costs, historical operating results, and indices proven over time from historical mine operations. Mining costs, because of the history of the mine and the usage of proven mining techniques should therefore be well defined and reliable. In our assessment of the mining economics, we have assumed the professionalism employed to produce the plan is appropriate to generate reliable and accurate mining cost estimates. Saknakshiri, on this matter, indicated their level of confidence in their mining economic costs was plus or minus 10%.

3.4 MINE ECONOMIC ANALYSIS

After reviewing the mine economics and entering into detailed discussions relative to the meaning of each cost category we developed a western style financial economic analysis to provide an indication of the potential economics of the Tkibuli mine complex. This analysis assumes that mining cost estimates appropriately represent the mining costs that will be realized by the Tkibuli mine complex. We have also assumed an arbitrary benchmark coal price of $30 per tonne. This price has been often offered in the Georgian market information as a price that will produce a reasonable profit.

The mine economic analysis we developed assumes the production build-up and follow-on delivery schedule included in the economic cost summary provided by Saknakshiri. The build-up schedule was developed to generate mine break-even cost information for Saknakshiri and Tkibulnakshiri management and is not related to likely market volumes that will be sold. The annual coal sales volumes within the economic analysis assume the primary market for the coal will be the Tkibuli coal-fired power station operating at full capacity. In our opinion, it is highly unlikely that the Tkibuli power station, if operating in a true free-market condition, will be able to compete for power sales to the extent that even 50% of its capacity would be used. Therefore, it is highly unlikely that the sales volumes envisioned for the Tkibuli power station assumed in this economic analysis will be realized (see chapter 4). Additionally, other markets are not specifically identified and coal prices are unjustified and arbitrarily assumed. Therefore, the revenue contemplated in this economic plan is susceptible to a high degree of risk.

We recommend that alternate economic analyses, based on likely coal sales scenarios, be developed to provide management with more information concerning the risk of market sales volumes and prices. It is also recommended that computers be purchased and employed, with training, to greatly expand Saknakshiri and Tkibulnakshiri's analytical capability.

We conducted an analysis of the Tkibuli mining operation cost summary. It is our opinion that these costs have been professionally prepared. Our level of work effort does not allow an in-depth analysis of the mining costs so our comments refer to the mining cost summary and profitability analysis. In this work, we noted Saknakshiri's adherence to treatment of capital-cost

recovery taxation policy as established by the Government of Georgia[2]. This policy, to some degree, is similar to that employed in the United States, where an investment, for taxation purposes, is allowed a specific time to be recouped. In our economic analysis, we noted that even after 18 years, initial capital investments within the first three years had not even been recouped because of taxation policies that do not allow investment to be properly recouped.

It is recommended that capital investment recovery rate policies for the mining industry be reviewed to develop recommended policies for the Government of Georgia which are more conducive to developing better rates of return within this capital intensive sector.

The Georgian method of summarizing mining cost economics includes totaling all costs, including the amortized capital cost component. This methodology is unlike western methods wherein capital costs are segregated and summarized separately from operating costs. This is important, because potential western investors will automatically assume operating costs do not including a capital cost component and therefore would perceive Georgian mining costs as high. Subsequently, we restated Saknakshiri's operating costs as shown below in Tables 3-1 and 3-2.

Table 3-1 shows mining costs increase from about $2 million per year for the 50,000 tonne per year case in 2001 to about $15.8 million per year for the 700,000 tonne per year case in 2006. Major cost categories include mine production support (operating) costs, consumable items including fuel, electricity, and material costs, along with labor, social, centralized, replacement, and other expense cost categories. These categories do not follow the general western convention of cost categorization. For example, it is important to note that imbedded within the "wear and tear" cost classification in the last category are some capital costs. These costs include development capital costs, equipment, and other wear and tear cost items.

Table 3-2 provides this data in a cost per tonne format that is easier to analyze. This data, as in Table 3-1, shows mining costs, excluding initial capital costs (but including development and replacement capital) ranges between $22.52 and $38.30 per tonne, given the production assumptions employed. Once coal production reaches the 600,000 tonne per year level, mining costs drop below $25 per tonne. Given the investment capital requirement of $20 million, it appears the margin required to obtain a return on investment of about 20% will be about $5 to $6 per tonne.

We recommend that operating cost summaries be restated using western norms such that potential investors will more easily understand the results of the economic analysis.

[2] Tax Code of Georgia, Chapter II, Income and Profit Taxes – Adopted June 13, 1997, Article 53 - Exclusion of Research, Project, Scientific, Testing – Construction Works Costs, and Article 54, Amortization Expenses Based on Main Assets – including amendments of September 18, 1997.

Table 3-1

Annual Mining Cost Summaries

Based on Saknakshiri Financial Data

Thousands of $US Dollars*

Expense Item	2000	2001	2002	2003 - 2004	2005	2006 – 2018
Mine Production Volumes – Tonnes/year	50,000	100,000	300,000	600,000	650,000	700,000
Wood	$115	$330	$990	$1,458	$1,579	$1,602
Explosives	$23	$46	$138	$267	$289	$310
Detonators	$14	$28	$84	$166	$180	$192
Spare Parts	$130	$210	$498	$854	$890	$980
Cost Items > GEL 150	$180	$360	$973	$1,625	$1,760	$1,885
Water	$4	$8	$27	$46	$50	$53
Wear & Tear Items < GEL 150	$23	$31	$87	$277	$277	$280
Uniform Wear and Tear	$18	$27	$77	$217	$217	$230
Other Small Lot Materials	$100	$220	$250	$291	$300	$350
Supportive Materials	$607	$1,260	$3,124	$5,201	$5,542	$5,882
Fuel - Surface	$36	$63	$105	$139	$211	$136
Electricity	$183	$273	$395	$577	$625	$781
Industrial Support Works	$30	$45	$60	$309	$320	$370
Subtotal	$249	$381	$560	$1,025	$1,156	$1,287
Total Production Materials Cost	$856	$1,641	$3,684	$6,226	$6,698	$7,169
Labor Remuneration	$336	$448	$1,836	$3,731	$4,000	$4,440
Social Security Costs	$104	$139	$569	$1,188	$1,240	$1,376
Centralized Costs	$242	$377	$655	$1,072	$1,030	$900
Wear and Tear	$202	$310	$610	$890	$980	$1,036
Other Expenses	$135	$180	$270	$351	$448	$310
Non Production Expenses	$40	$80	$240	$502	$502	$530
	$1,059	$1,534	$4,180	$7,734	$8,200	$8,592
Total	$1,915	$3,175	$7,864	$13,960	$14,898	$15,761

* US$ foreign exchange rate assumed = 1.85 US$ per GEL

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Table 3-2

Annual Mining Cost Summaries

Based on Saknakshiri Financial Data

$US Dollars* Per Tonne

Expense Item	2000	2001	2002	2003 - 2004	2005	2006 – 2008	Cost %
Mine Production Volumes – Tonnes/yr.	50,000	100,000	300,000	600,000	650,000	700,000	
Wood	$2.30	$3.30	$3.30	$2.43	$2.43	$2.29	10.20%
Explosives	$0.46	$0.46	$0.46	$0.45	$0.44	$0.44	2.00%
Detonators	$0.28	$0.28	$0.28	$0.28	$0.28	$0.27	1.20%
Spare Parts	$2.60	$2.10	$1.66	$1.42	$1.37	$1.40	6.20%
Cost Items > GEL 150	$3.60	$3.60	$3.24	$2.71	$2.71	$2.69	12.00%
Water	$0.08	$0.08	$0.09	$0.08	$0.08	$0.08	0.30%
Wear & Tear Items < GEL 150	$0.46	$0.31	$0.29	$0.46	$0.43	$0.40	1.80%
Uniform Wear and Tear	$0.36	$0.27	$0.26	$0.36	$0.33	$0.33	1.50%
Other Small Lot Materials	$2.00	$2.20	$0.83	$0.49	$0.46	$0.50	2.20%
Supportive Materials	$12.14	$12.60	$10.41	$8.67	$8.53	$8.40	37.30%
Fuel - Surface	$0.72	$0.63	$0.35	$0.23	$0.32	$0.19	0.90%
Electricity	$3.66	$2.73	$1.32	$0.96	$0.96	$1.12	5.00%
Industrial Support Works	$0.60	$0.45	$0.20	$0.52	$0.49	$0.53	2.30%
Subtotal	$4.98	$3.81	$1.87	$1.71	$1.78	$1.84	8.20%
Total Production Materials Cost	$17.12	$16.41	$12.28	$10.38	$10.30	$10.24	45.50%
Labor Remuneration	$6.72	$4.48	$6.12	$6.22	$6.15	$6.34	28.20%
Social Security Costs	$2.08	$1.39	$1.90	$1.98	$1.91	$1.97	8.70%
Centralized Costs	$4.84	$3.77	$2.18	$1.79	$1.58	$1.29	5.70%
Wear and Tear	$4.04	$3.10	$2.03	$1.48	$1.51	$1.48	6.60%
Other Expenses	$2.70	$1.80	$0.90	$0.59	$0.69	$0.44	2.00%
Non Production Expenses	$0.80	$0.80	$0.80	$0.84	$0.77	$0.76	3.40%
Subtotal	$21.18	$15.34	$13.93	$12.89	$12.62	$12.27	54.50%
Total Operating Costs	$38.30	$31.75	$26.21	$23.27	$22.92	$22.52	100.00%

* US$ foreign exchange rate assumed = 1.85 US$ per GEL

Table 3-2 also shows some important information about mining costs. Although labor costs are low on an individual basis they represent 37% of operating costs, when the labor tax component is added, and equals $8.31 per tonne. If labor and social tax costs increase by 20% the impact upon the price of coal will be an increase of $1.66 which would represent 28% of a $6.00 per tonne profit margin. Given the low labor cost, the difficulty experienced by the populace in earning a living, and a potential for adverse labor pay reaction this risk can not be discounted. The mine plan is labor intensive.

Labor levels expected at the mine are estimated at 800 personnel for the 50,000 tonne case and 1,350 personnel for the 700,000 tonne per case. Our depth of analysis does not permit comment upon the appropriateness of these figures as one must consider the work requirements for each labor classification, the degree of mechanization employed, and the amount of mine development work required for the particular levels of production contemplated. We have observed that in several FSU countries, employers of local importance tend to be obligated by the community to maximize employment of the community members. Therefore, the number of personnel and personnel costs in FSU countries generally appear rather high.

We recommend that as mine production begins, Tkibulnakshiri take specific steps to instill a new productivity standard for the Tkibuli mines. Recent low coal production coupled with non-payment of wages and little work requirement will have instilled a work mode that must be immediately changed when production at the mines restarts. A policy of ensuring high labor productivity and lower numbers of employees should be implemented.

During our economic analysis, another primary change we instituted into the economic analysis was to develop a cash flow forecast by adding the capital amortization schedule back to profits after tax and then deducting the capital spending from the sums for each year. Based on advice from Saknakshiri, we deducted $7.3 million for initial equipment in the first three years, on an equivalent basis. The impact of this effort on the economic analysis is to increase the cash out-flow during the earlier years and increase cash in-flows later in the project. Therefore, economic rates of return and net present values will decrease when this adjustment is made. This change allowed us to develop indicative rates of return and net present values for the Tkibuli Mine economic case provided by Saknakshiri. The remainder of the $20 million initial investment, $12.7 million, represents mine development costs and were said by Saknakshiri to be included in mine production costs. Saknakshiri's analysis, because of their methodology, only recognized capital from an amortization and taxation perspective.

We recommend that final economic analyses be summarized in a form that shows all capital spending by year such that potential investors can easily determine the initial, replacement, and development capital items as well as cash flow.

In spite of capital cash flow cost category assumptions by Saknakshiri, there is value in determining the internal rate of return for the coal market volume and price conditions. We have assumed the coal sales volumes and realization price of $30 per tonne proposed by Saknakshiri. The mine economic analysis shows that under these conditions, the mine could be attractive to

potential investors, given market assumptions. The result of our assessment is summarized below in Table 3-3.

Table 3-3

Tkibuli Mines Profitability Summary

Economic Variable	Millions	Per Tonne
Sales Tonnes	11.3	1
Initial Capital Investment	20.0	$1.77
Revenue – US$	$338.91	$30.00
Operating Costs – US$	$240.93	$21.32
Non-Production Costs – US$	$1.36	$0.12
Property Tax – US$	$3.57	$0.32
Value Added Tax – US$	$56.60	$5.01
Amortization of Capital – US$	$17.35	$1.54
Subtotal Costs – US$	$319.80	$28.30
Profit Before Income Tax – US$	$19.11	$1.69
Income Tax – US$	$3.39	$0.30
Profit After Income Tax – US$	$15.73	$1.39

We developed economic indicators for the Saknakshiri economic information. We assumed, as mentioned earlier, the $20 million in initial capital expenditure spent in the first three years. Our analysis suggests that the indicative internal rate of return for the Tkibuli mine economics is about 12%. This rate of return is sufficient to suggest the economic potential of the Tkibuli mines is acceptable. The economics are susceptible to improvement and optimization, such as the mine closure impact, so potential investors could be attracted. We assume a potential investor would be attracted to an after tax rate of return in the neighborhood of 20%. On the down side, the net present values for this project are rather low and may not attract major mining companies. The economic indicators we developed for the Tkibuli mine economics are shown below in Table 3-4.

Table 3-4

Tkibuli Mines Economic Indicators

Indicator	Current Case	Current Case with Mine Closures
Internal Rate of Return	12%	14%
Net Present Value - $US	$1.1 million	$2.90 million

It is important to note the heavy impact the value-added tax has upon the profitability of the Tkibuli mines. This 20% tax greatly increases the cost of coal and therefore represents an area wherein the Government of Georgia can produce an incentive, by reducing or eliminating the tax, to create an economic coal sector.

In our opinion, the breakeven point for profitability may not be adequately determined. As mentioned earlier, other production cases could be analyzed to provide management with additional information concerning the breakeven point for the mine and relationships to coal price realizations.

We recommend management analyze coal production capacity in the range of 200,000 to 400,000 tonnes per year more thoroughly. If coal sales in this range can only be achieved in the near term then it may be critical to the life of Tkibuli to be able to profitably produce coal in this production range for an extended period. It is additionally recommended that modern computers be used in this evaluation such that results can quickly be generated.

3.5 FACTORS AFFECTING COAL PRODUCTION ECONOMICS

The economics of selling coal products are greatly dependent upon potential markets, the quality of product which can developed for these markets, and the competitiveness of the coal products which can be developed. The primary factors affecting underground mining economics are:

1. Depth of mining and requirements for mine development.
2. Factors affecting safe working conditions.
3. Capital requirements to develop mine production at required quantities.
4. Production requirements relative to labor market, cost, and productivity.
5. Mechanization of coal extraction.
6. Mechanization of coal transportation from the coal face to the surface.

At Tkibuli, the mine complex has been in operation for many years but more recently has been somewhat dormant. One positive factor here is that the mines have not encountered any water during mining operations. This is positive in that pumping costs to keep mine operating conditions within a manageable range can be somewhat high and detrimental to mining economics.

Table 3-5

Initial Capital Equipment Requirement Costs – $US

Equipment	Units	Quantity	Unit Price	Total Cost
Conveyor S-53	Lot	16	$30,000	$480,000
Conveyor SR-70	Lot	12	$50,000	$600,000
Local Ventilation Fans SVM-6	Piece	12	$3,500	$42,000
Ventilation Pipe – 600 mm	Gram/m	1500	$200	$300,000
Magnetic Dispatch	Piece	70	$2,000	$140,000
Automatic Dispatch	Piece	20	$2,500	$50,000
Miscellaneous Flexible Cable	Gram/m	3000	$8	$24,000
Shielded Cable	Gram/m	2500	$10	$25,000
Waste Rock Transport Tuck	Piece	4	$80,000	$320,000
Railway Track 10-33	Tonne	100	$60	$60,000
Mine Diesel Locomotive	Piece	6	$100,000	$600,000
Blast Drill B-1	Piece	4	$50,000	$200,000
Well Drill	Piece	10	$30,000	$300,000
Compressor ZIF-5	Piece	5	$25,000	$125,000
Cracking Hammer	Piece	30	$60	$1,800
Perforator	Piece	30	$100	$3,000
Mine Transformer	Piece	10	$30,000	$300,000
Mine Hoisting Equipment	Piece	10	$20,000	$200,000
Mine Hoist Equipment D-24	Piece	10	$6,500	$65,000
Miner's Lights SDG-5	Piece	1500	$80	$120,000
Self Rescuers	Piece	1500	$30	$45,000
Miscellaneous Electric Motors	Piece	50	$1,000	$50,000
Pipeline – 4 inch	Tonne	100	$700	$70,000
Spare Parts – Unit 1	Lot	–	$–	$150,000
Truck	Piece	4	$80,000	$320,000
Tractor T-130	Piece	4	$60,000	$240,000
Excavator – 30	Piece	2	$50,000	$100,000
Loading Unit KS	Piece	4	$90,000	$360,000
Mine Electric Locomotive	Piece	4	$100,000	$400,000
Batteries	Piece	8	$45,000	$360,000
Hoist Ropes	Gram/m	5000	$5	$25,000
Explosive Inventory	Tonne	200	$1,500	$300,000
Spare Parts – Unit 2	Lot	–	$–	$200,000
Other Unidentified Equipment*	--	--	$–	$738,000
Total				$7,313,800

* Detailed information did not match statements of required capital requirements. Authors inserted amount to ensure amounts total properly.

The cost of the initial capital, estimated at $20 million, envisions $12.7 million in mine development and reconstruction work to re-establish production capability. This work includes the driving of underground mine openings to reach the areas of the mine where excavation will take place. These development workings are absolutely necessary. We have not reviewed

mining plans to the extent possible to establish if there are any other methodologies that could be employed to increase productivity, reduce capital costs, or balance potential productivity with capital costs to optimize the mining plans. The remainder of the initial capital investment is for equipment and is shown in Table 3-5. We have not reviewed initial capital relative to the mine development and production requirements. Much of the equipment included in the list is typical of capital equipment required for mine production in this type of mine.

The markets for coal are a major determinant of mining economics. Given substantial requirements for mine development in order to produce coal, the initial capital investment necessary must be balanced with likely markets for coal. If estimates of coal sales can not be realized then the development investment in the mines can not be recouped for any value, and therefore represent a very high degree of risk to an investor. However, the investment in equipment can be recouped to some degree by selling assets that remain, in case the mining venture turns out to be non-profitable. Defining future coal markets is crucial in establishing the profitability and economic potential while reducing the risk of an underground mine of this type.

Within the economics of producing coal and transporting it to the surface is the question of further coal beneficiation. Any beneficiation to prepare the coal for specific markets must be identified and analyzed. Beneficiation may require simple crushing or more complex systems to size the coal and remove unwanted impurities. In addition, the transportation costs to ship coal to customer locations must be considered. The delivery point will either be at the mine site, the customer facility or an intermediate point such as a port. All of the costs to deliver the coal to the delivery point of each specific market must be considered within the economic analysis. Therefore, coal beneficiation and delivery costs must be either considered in the cost to produce the coal or in the price established for each particular coal market.

3.6 POTENTIAL TO REDUCE MINING COSTS

During our assessment we looked for opportunities to enhance the potential to develop a profitable mining complex at Tkibuli, assuming profitable markets existed. Our cursory review of the potential to reduce mining costs determined that opportunities might include:

1. Producing all coal from mines and shafts having greater capacity and greater productivity.
2. Employing mechanized mining equipment.
3. Employing improved mining methods to increase productivity.
4. Producing a higher quality coal product.
5. Reclaiming coal from waste coal dumps.

6. Developing income from coal bed methane resources.

For item numbers 1 through 3, there may be potential to improve operations and profit. The Tkibuli mines employ a great deal of labor, which is relatively inexpensive but does increase risk of higher future labor rates. The primary impact though, is the lower productivity realized from little mechanized equipment. Management of the Tkibuli mines is confronted by a serious shortfall of capital such that they have even more limited choices in the mining methods and equipment. Mining methods, nonetheless, as mentioned earlier, are also dependent upon geologic conditions.

Because of Georgia's relative exclusion from the international coal industry, there may be value in canvassing world wide coal operations to search for similar mining conditions to learn from any experiences of mechanized coal extraction that may exist. We recommend that this task be executed.

For item number 4, we worked to determine if there was potential to produce a higher quality product by removing more ash and/or sulfur from the coal. As mentioned in Chapter 2, there may be potential to produce a better product. Additional analyses, using western techniques, are required in order to determine this potential.

For item number 5, we eliminated the potential to reclaim coal from waste dumps. We primarily were looking for fine coal wastes that would have a high coal content. Unfortunately, for this purpose, coal fines were de-watered during coal beneficiation at the old plant and shipped to customers. The waste coal that is available is a 7.5 million tonne coarse reject dump near the mine. The coal content is estimated to be about 25% which is therefore likely uneconomic, given the size of the resource, the amount of coal that could be extracted, and beneficiation cost economics such that a stand-alone beneficiation plant likely wouldn't make sense.

For item number 6, the coal-bed methane production looks to have potential promise. Information indicates that potential for coal-bed methane concentrations may be in the neighborhood of 15 cubic meters per tonne. A concentration over 9 cubic meters per tonne within a total coal bed thickness of over 10 meters should be considered as a resource with good potential. The overall economics will be dependent upon regional gas-system connection requirements and relative gas-field development economics. We understand that an agreement has been struck to develop this potential. We did not review rights Saknakshiri may have to any royalties or profits from this project as this potential appeared to be already defined by agreement.

CHAPTER 4
COAL MARKET

4.1 HISTORICAL COAL MARKET

The historic coal market in Georgia is comprised of both import and export components. The coal production, import and export markets are shown below in Table 4-1.

Table 4-1

Georgia Coal Production and Import/Export Markets

Thousands of Metric Tonnes

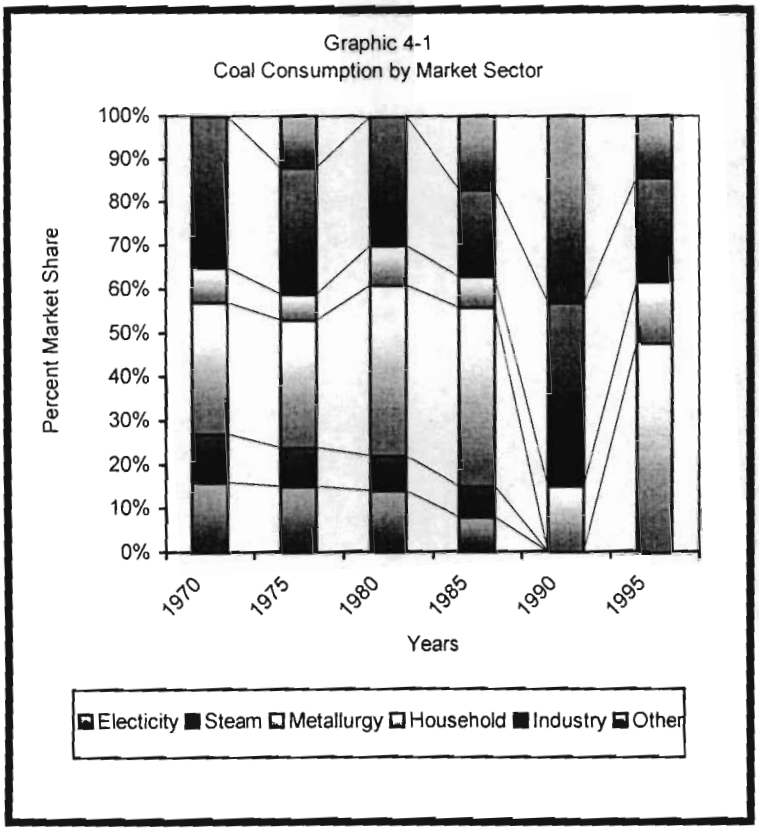
	Coal Production				Market Demand		
Year	Akhaltsikhe	Tkvarcheli	Tkibuli	Total	Imports	Exports	Domestic (b)
1960	208	1,244	1,398	2,850	1,371	105	4,116
1965	180	1,006	1,435	2,621	73	101	2,593
1970	108	952	1,238	2,298	925	162	3,061
1975	51	758	1,243	2,052	829	76	2,805
1980	50	598	1,212	1,860	1,086	162	2,784
1985	24	469	1,181	1,674	868	432	2,110
1989	0	127	997	1,124	0	295	829
1990	0	290	664	954	0	245	709
1991	0	150	546	696	0	180	516
1992	0	na	78	78	0	110	???
1993	0	na	82	82	0	31	51
1994	0	na	44	44	0	16	28
1995	0	na	43	43	5	7	41
1996	0	na	23	23	20	0	43
1997	0	na	5	5	na	0	5
1998	0	na	15	15	na	0	15
1999e	0	na	8	8	na	0	8

notes: e: estimated

(a) na: information not available

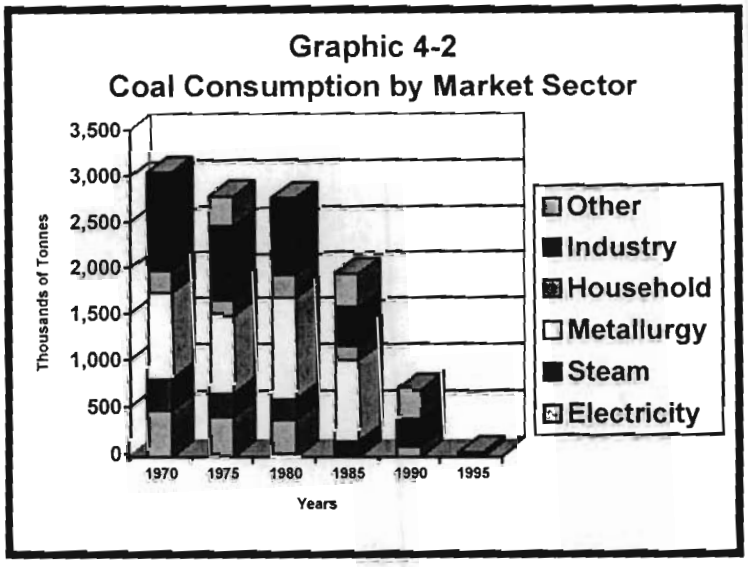
(b) includes demand in Abkhazia for the Tkvarcheli coal at the power station

The table above shows domestic coal consumption fell from 4.1 to 2.8 million tonnes in the 1960 to 1980 period and finally down to 43,000 tonnes in 1996. The traditional shares of coal consumption in Georgia by market sector are provided in Graphic 4-1.



Graphic 4-1 shows electricity and steam markets for coal began steadily decreasing in 1970 and had disappeared by 1990. Meanwhile, the industrial and metallurgical markets maintained their share of coal being consumed in Georgia. The household market appears to be growing while the other category shows an odd historical pattern that may indicate poor information collection or data reporting. It is important to realize that the coal volumes consumed dropped drastically during this period of time. Therefore, it is important to analyze this information from a volume of fuel consumed perspective. This information is provided in Graphic 4-2.

Graphic 4-2 also shows the dramatic loss of the electricity, steam, and metallurgy markets between 1985 and 1990. Although the household and industry markets maintained half of their original markets through 1990, demand here as well in the other category evaporated during the Georgian economic crisis during the first half of the decade. Importantly, this chart shows coal markets were declining before the economic crisis of the 1990s as other fuels gained favor or economic advantage.



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4.2 CHANGES IN THE COAL MARKET

The primary change in coal markets began occurring during the early 1980's when the combined heat and power (CHP) stations were converted to use natural gas. As can be seen in Table 4-1, during the seventies, domestic coal demand was essentially flat at 2.8 million tonnes of coal, while during the eighties, coal demand dropped to 2.1 million in 1985 and 709,000 tonnes by 1990. Exported coal did pick up slightly from 162,000 tonnes in 1980 to 432,000 in 1985 before settling back to 245,000 tonnes in 1990. Imports decreased from 1980 to 1990 by 1.1 million tonnes. The net result during the eighties was a total reduction in demand of 2.1 million tonnes (75%). This reduction was largely made up of imported coal deliveries dropping 100% and domestic production dropping from 1.86 million to 954,000 tonnes, for a 49% decrease.

This market reduction included a 308,000 reduction in demand resulting from lower amounts of coal used for the coal-fired power station in Abkhazia that burned Tkvarcheli coal. Total coal production at the Tkibuli mines responded to the loss of markets during the eighties by reducing coal output from 1,212,000 tonnes in 1980 to 664,000 tonnes in 1985, for a 46% drop. The Tkibuli production during 1990 included 245,000 tonnes of coal being exported to Ukraine.

During the nineties, domestic and export coal demand evaporated from a level of 709,000 tonnes in 1990 to 41,000 tonnes in 1995, which represented a 94% decrease. Coal sales of 245,000 tonnes in 1990 to Ukraine's Khorakova power station disappeared by 1995. Of the remaining domestic demand in 1990, 94% was eliminated during the economic collapse. During the nineties, remaining domestic and export coal demand evaporated. A coal market of 2.8 million tonnes per year was eliminated during the 15-year period from 1980 to 1995.

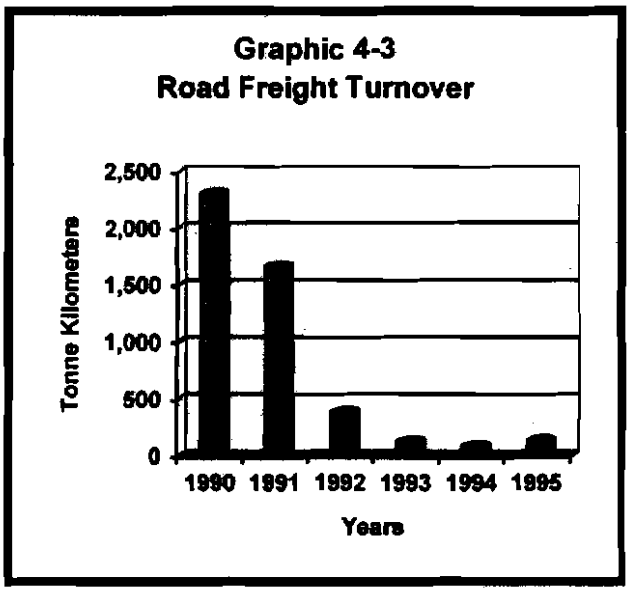
4.3 TRANSPORTATION OF COAL

Coal can be transported from the Tkibuli mines by truck or by rail. In Georgia, the privatization of the road freight sector is almost complete, although many of the "joint stock" companies are completely owned by the state with a majority of firms having at least 60 to 70% state ownership. It is assumed that private ownership interests intend to purchase state-owned portions in the future. Meanwhile, the rail system has not been privatized.

4.3.1 Coal Transport by Truck

Truck haulage is generally used for local markets. Ten tonne trucks, such as the KAMAZ 53212 Supermaz, are generally employed in Georgia to haul bulk materials. Coal load-out facilities at Tkibuli can store up to 1200 tonnes of coal.

Highway haulage of bulk commodities is commonly employed throughout the world to transport products from producer to market. Graphic 4-3 shows the freight turnover for freight hauled on roads for the period 1990 to 1995 according to TRACECA[1] (Transport Corridor Europe Caucasus Asia). The sector has not recovered to any significant degree since 1995.



In Georgia, one primary issue of concern is the impact the poorly performing economy has had upon the transport sector. Currently, the supply of trucks in Georgia should be sufficient, according to recent studies. Another TRACECA[2] report on roads states:

> *"At present, the capacity of the vehicle fleet exceeds the demand. It is likely that growing transport demand will absorb part of this capacity. However, a substantial renewal of the fleet will nevertheless be necessary when economy revives, not because the vehicles are technically obsolete, but because they do not meet the new transport demand (larger amounts transported by road instead of rail) and for international transports. The existing fleet can be used to absorb the local and regional growth of transport demand the coming years and to generate income for the investment in (second hand) vehicles that meet international standards."*

The mines at Tkibuli are connected to the national transport grid by paved highway. This roadway has historically been used to transport coal to local markets. Georgian roads are designed based on Soviet standards. According to TRANCECA report referenced, "The total length of the Georgian road network consists of 21,600 km of roads, of which 9,720 are paved and 11,800 are gravel or earth." The trucks in Georgia, which are estimated to total 100,000 in number, are generally 15 to 20 years old and should be replaced. Hence, the relative costs of truck haulage are high in Georgia. It is also estimated that roughly 80% of most trucks are currently not being used.

Truck haulage operating costs for a 10 tonne truck are estimated from the referenced TACIS reports at $0.75 (GEL 1.39) per kilometer, given a 10 tonne truck and the normal road conditions

[1] TRACECA Improvement of Road Transport Services Report, April, 1997, page 104
[2] TRACECA Improvement of Road Transport Services Report, April, 1997 on page 14

in Georgia. Mine management indicates that current market prices are said to be about GEL 1.30 per kilometer for a 12 tonne truck. This is equivalent to a cost of GEL 0.108 per tonne-kilometer which, at current $US foreign exchange rates, is equivalent to about $0.059 per tonne-kilometer. An assumption, therefore, of $0.06 per tonne-kilometer is considered as reasonable for purposes of this report. In the US, coal haulage by truck is estimated to cost $0.06 to $0.12 per tonne-kilometer range.

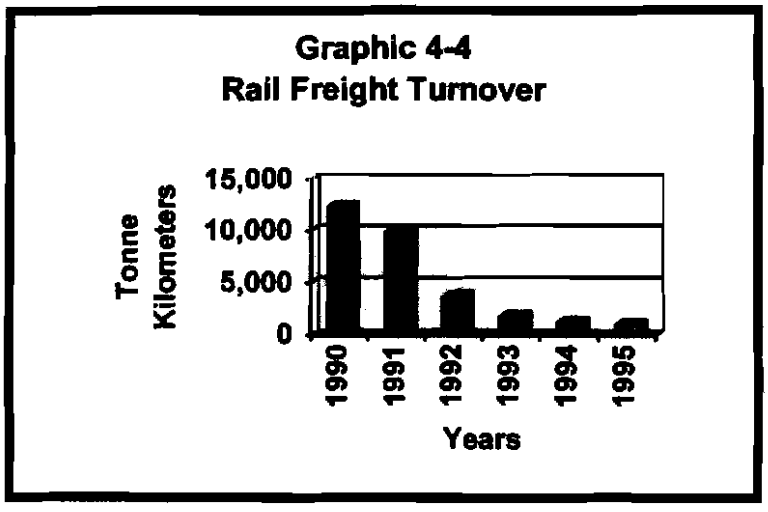
4.3.2 Coal Transport by Rail

Coal haulage by rail can also be employed from the Tkibuli mines. Historically, coal was shipped by rail to domestic and foreign markets. The rail car loading point, or tipple, is located at the mine site. A 1200 tonne hopper is used at the tipple to load rail cars and the current rail bed near the mine needs to be replaced to increase transport speeds.

Rail haulage of bulk commodities is commonly employed throughout the world to transport products over longer distances from producer to market. In Georgia, one primary issue of concern is the impact the poorly performing economy has had upon the transport sector. According a TACIS[3] Report:

"Because of the economic situation, but also due to the political development in the region, there is a dramatic decline in the transport volume of the [railway]. This quantitative drop was accompanied by a deterioration in quality of the transport services."

The report goes on to provide the historical freight turnover for rail transport as is shown in Graphic 4-4. The system includes 1839 km of rail system of which 100% is electrified and 18.5% is double tracked. There are about 230 locomotives and 21,000 freight wagons in the system. The rolling stock is old while the wagons are poorly managed to ensure spares are available to optimize productivity. According to the referenced report, 78% of the wagon stock is not used because of low freight volume.



[3] TACIS Report, Trans-Caucasian Railway, 1996, page 1

A 1999 TACIS[4] report analyzes freight haulage potential. The report provides more detail than the report referenced above and is shown below in Table 4-2.

Table 4-2

Georgian Rail Freight Haulage Equipment Status

Equipment	# Total	# Available	# Needing Maintenance	# Required For 8.5 M Tonnes	# Required For 12.5 M Tonnes
Electric Locomotives	241	83	20	55	69
Diesel Locomotives	10	1	9	0	0
Shunting Locomotives	175	63	na	na	na
Wagons	19,507	6,419	13,000	3,993	4,917

note: na: information not available

Table 4-2 references 1998 and projected 2003 freight haulage levels of 8.5 and 12.5 million tonnes, respectively, as a frame of reference for haulage capacities. For comparison purposes, in 1988, the system hauled 36.2 million tonnes of freight. This information shows there appears to be sufficient capacity to provide the transport of coal if market conditions are warranted. It is likely that rail productivity could be enhanced through injections of capital for purchase of new equipment and making necessary repairs. We conclude that the rail system should have adequate capacity to transport the volumes of coal envisioned in mine development plans for the Tkibuli coal complex that forecasts a maximum coal volume of only 700,000 tonnes.

Rail haulage costs from the referenced 1999 TACIS report indicated 1988 costs were 3.112 tetries per tonne-kilometer. This equates to a current cost, in US dollars, of $0.017 per tonne-kilometer, assuming a US$ foreign exchange rate of 1.85 US$ per lari. This cost is considered reasonable in contrast to US costs wherein costs along the line of $0.02 to $0.03 per tonne-kilometer are often observed as the norm.

4.3.3 Coal Haulage Economics

The forgoing sections indicate that there is adequate capacity for coal haulage by rail or by truck. This is borne out by mine officials who indicate that, in their opinions, both the rail and the truck haulage can provide adequate haulage capacity of up to 1.5 million tonnes per year.

[4] TACIS report, Restructuring of Georgian Railways, Freight Business Unit: Business Plan 1999-2003, September 1999

The cost of road and rail transport for domestic markets can be calculated based upon the cost per tonne-kilometer assumptions derived above, $0.06 and $0.017, respectively. For the purposes of this report, this information can then be used to estimate the cost of coal on a delivered basis to distribution points throughout Georgia. This information can also be extrapolated on a more regional basis as tariff and duty costs are defined. The transportation costs for both road and rail throughout Georgia are shown below in Table 4-3 for differing haulage distances, in kilometers:

Table 4-3

Cost of Coal Transportation by Road and Rail

Throughout the Republic of Georgia

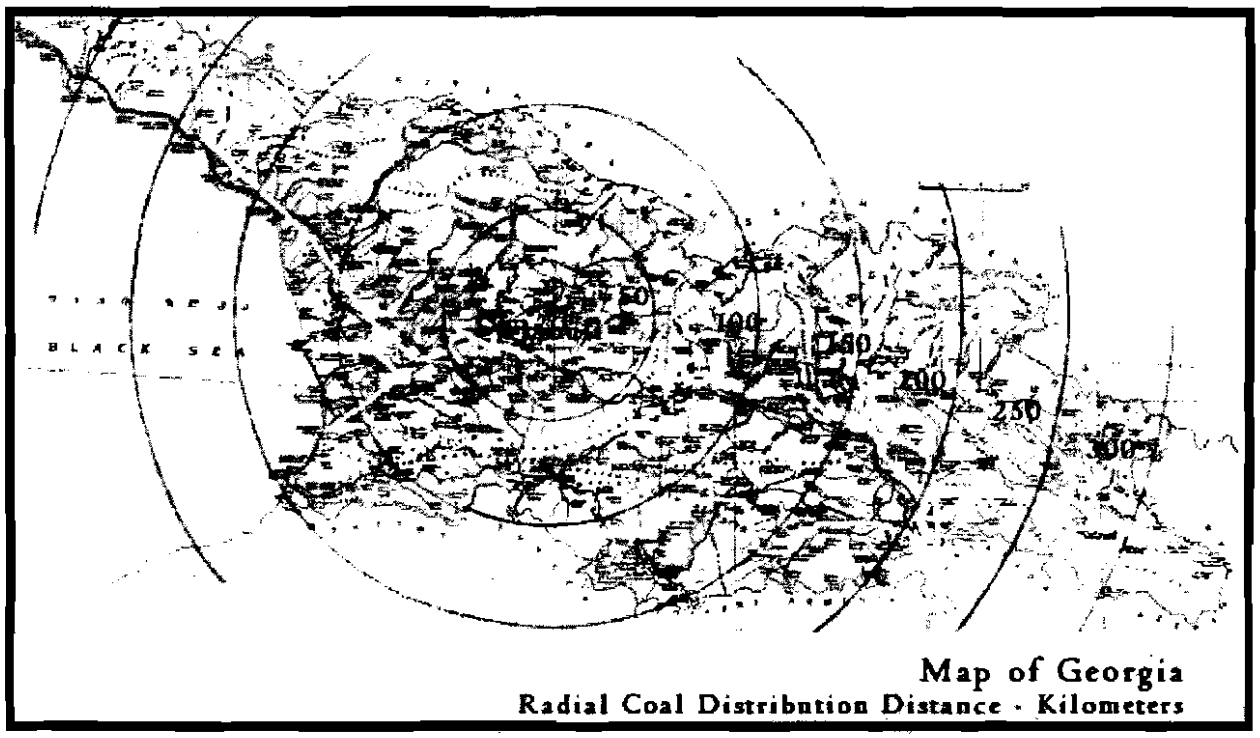
Haulage Distance – km	Road Transport Cost - $/Tonne	Rail Transport Cost - $/Tonne
50	$3.00	$0.85
100	$6.00	$1.70
150	$9.00	$2.55
200	$12.00	$3.40
250	$15.00	$4.25
300	$18.00	$5.10
350	$21.00	$5.95
400	$24.00	$6.80
450	$27.00	$7.65

Table 4-3 shows the cheapest form of transport for Tkibuli coal, given current transport costs, is rail. By referring to the map below it can be seen that the cost to transport coal by rail to the farthest reaches of Georgia would be about $5.10 per tonne. This information can be used to determine if Tkibuli coal can compete with other forms of fuel in the energy market. If one assumes an operating cost of $25 to $30 per tonne then coal could be delivered for a price of roughly $30 to $35 per tonne anywhere within Georgia, excluding unloading and destination handling costs.

Because Georgia, and its immediate neighbors, are somewhat removed from other international coal sources, coal shipments into the region by rail will very likely be too expensive and will not be able to compete with Georgian coal products. The other alternative is transport of coal into Georgia by sea. The cost of international coal transport and handling for coal imports was determined to be rather expensive through Georgian ports. The port that can handle and would

be used for coal imports is the port of Poti. Officials at the port of Poti quoted a price for importing coal that would add at least $4.50 per tonne to the price of the coal. The competitiveness of coal imports into the Georgian market, as well as export of Georgian coal is addressed in section 4.6 of this report.

Graphic 4-5



4.4 POTENTIAL COAL MARKETS FOR THE CURRENT BUSINESS PLAN

Volumes of coal planned for the market in the economic plan, as mentioned earlier in this report, are not completely based upon market expectations. The volumes of coal produced within the study represent two cross-purposes. The volume of coal produced is based primarily upon the proposed Tkibuli coal-fired power station but the remainder of the initial production has no specific market identified and is primarily used to develop break-even cost criteria for the mine. A specific marketing plan is not included either within the economic study or within the current

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business plan, which is out of date. In Saknakshiri's business plan,[5] many markets have been reviewed to some degree but the timing of market demand, how coal will specifically compete with competitors on price basis, and other price related issues are inadequately addressed. For example, the five-year plan coal markets and prices are reproduced below in Tables 4-4 and 4-5.

Table 4-4

Coal Marketing Five-Year Plan

Tonnes

Consumers	1996	1997	1998	1999	2000
Population, Municipal-Household	30,000	50,000	80,000	80,000	150,000
Export	25,000	25,000	25,000	25,000	30,000
Industry (for technology purposes)	20,000	20,000	25,000	100,000	200,000
Building materials industry	0	0	100,000	100,000	200,000
Thermal Power Station	0	0	0	0	200,000
Total	75,000	95,000	230,000	*305,000	*780,000

* Amounts stated in the report did not accurately total, so totals were revised to the sum of components.

Table 4-5

Coal Marketing Five-Year Plan

Laries per Tonne**

Consumers	1996	1997	1998	1999	2000
Population, Municipal-Household	36.00	36.00	36.00	36.00	36.00
Export	40.00	40.00	40.00	40.00	33.33
Industry (for technology purposes)	23.00	30.00	40.00	37.00	37.00
Building materials industry	0.00	0.00	37.00	37.00	37.00
Thermal Power Station	0.00	0.00	0.00	0.00	25.00
Average	33.87	35.79	37.30	*36.98	*33.59

* Amounts stated in the report did not accurately total, so totals were revised to the sum of components.

** The report cited provided total Laries that were divided by tonnage figures to provide these statistics.

[5] Development of an energy policy in Georgia, Extension TACIS/92/EGE 001, Coal Sector Development Interim Business Plan, May 1996.

There is no detail within the report to justify the volumes contemplated for the markets. This problem is borne out by the fact that the coal markets contemplated never materialized. It must be summarized therefore that this marketing plan represents hope and wishful thinking rather than a reliable expectation of future markets. In addition, there is no justification and support whatsoever for the coal prices that have been assumed.

The current business plan is outdated. We recommend a new business plan be developed which includes a dependable market forecast. This business plan should be developed every year. The new business plan should establish goals and then focus upon planned work activities required to achieve these goals. Action plans and goal achievements should be reviewed monthly to ensure performance targets are met. If markets need to be re-developed then the marketing and business plans should recognize this need and plan business activities to achieve realizable goals. Coal prices assumed should be based upon point-of-sale issues, competitive studies, distribution costs, and other dependable market research.

The coal quality requirements of the coal market defined in the business plan are not clear. There is much discussion about differing markets requiring specific coal sizing and quality but there is no discussion about the use or construction of a coal beneficiation facility. The business plan must be clear as to whether a coal beneficiation facility is needed for the markets perceived. If a coal beneficiation plant is not envisioned then discussions and assumptions about the coal market should not consider any products requiring beneficiation.

4.5 ANALYSIS OF A COAL-FIRED POWER STATION IN GEORGIA

The primary coal market defined in the business plan and the recent economic study produced by Saknakshiri is a coal-fired power station to be constructed within the Tkibuli mine region. The concept includes the construction of a 125MW unit to be followed by an identical unit once market demand increases. We have analyzed this concept to provide independent insight into the feasibility of this potential market.

We forecast that if a 125 MW unit is constructed it will cost the economy of Georgia dearly. Throughout the world, it is accepted that for new construction projects, natural gas power plants generally are more economic than coal-fired plants, if natural gas costs are reasonable. This economic reality is particularly true in Georgia because of the benefit of extensive regional gas supplies available at low prices. Employing a least-cost planning model for future electricity demand in Georgia shows that if a 125 MW coal-fired power station is constructed, rather than a comparable size gas-turbine plant, it will cost Georgian electricity consumers the equivalent of US$35 to $61 million per year in excess electricity costs. We expect this differential to fall on the higher end because investors will likely expect an after tax rate of return of at least 20% because of the investment risks in Georgia.

The 125 MW coal-fired power station, with the necessary mine and rail investments, will have a capital cost of $200 million whereas a 125 MW gas-turbine plant is projected to only cost $55 million. Because coal-fired power station operating costs are higher than a gas-turbine station (we have assumed a coal cost of $30 per tonne and a natural gas cost of $60 per thousand cubic meters) this compounds the problem of high initial capital costs to make a poor situation even worse. In order to achieve internal rate of returns of 15% and 25%, before income tax, electricity tariffs of $0.080 and $0.119 per kWh must be charged for the coal-fired plant, respectively. This contrasts to tariffs of $0.037 and $0.044 per kWh, respectively, for a gas-turbine plant or $0.040 and $0.054 per kWh for a 125MW combined cycle plant. Assuming 7,000 operating hours per year and 814 gWh of electricity production per year, we've arrived at the results stated above. If the second coal-fired 125 MW unit is constructed then the unnecessary cost to the economy will likely range from $50 to $100 million, every year.

The following tables, 4-6 and 4-7, contrast the cost to produce electricity from competitive power station technologies. Given plant capital and operating costs, they show the tariff that must be charged to ensure the appropriate rate of return. The tables also show the economics of the power plant even if they were able to purchase coal at a $10 per tonne price. This comparison shows the decision to build a coal-fired power station is not really dependent upon the coal price.

Table 4-6

Power Station Cost Comparisons

Operating 7,000 hours producing 814 (a) gWh per year

For a 15% BIT IRR (b)

Plant	Capital Cost $M	Tariff $/kWh	Electricity Cost $M per Year	Differential Tariff Cost to Lowest Alternative $M/ Yr.	Differential Capital Cost to Lowest Alternative $M
Coal @ $30/t – 125 MW	$200	$0.080	$65	$35	$145
Coal @ $10/t – 125 MW	$200	$0.069	$56	$26	$145
Gas Turbine – 125 MW	$55	$0.037	$30	$0	$0
Combined Cycle – 125 MW	$199	$0.040	$33	$3	$48
Combined Cycle – 400 MW	$200	$0.024	$67	$37	$145

(a) Applies for all 125 MW plants except the 400 MW plant that produces 2800 gWh per year.

(b) Before Income Tax Internal Rate of Return

Table 4-7

Power Station Cost Comparisons

Operating 7,000 hours producing 814 (a) gWh per year

For a 25% BIT IRR (b)

Plant	Capital Cost $M	Tariff $/kWh	Electricity Cost $M per Year	Differential Tariff Price to Lowest Alternative $M/Yr.	Differential Capital Cost to Lowest Alternative $M
Coal @ $30/t – 125 MW	$200	$0.119	$97	$61	$145
Coal @ $10/t – 125 MW	$200	$0.108	$88	$52	$145
Gas Turbine – 125 MW	$55	$0.044	$36	$0	$0
Combined Cycle – 125 MW	$103	$0.054	$44	$8	$48
Combined Cycle – 400 MW	$200	$0.028	$78	$42	$145

(a) Applies for all 125 MW plants except the 400 MW plant that produces 2800 gWh per year.

(b) Before Income Tax Internal Rate of Return

In the information above, we have assumed that all plants are connected to their fuel supply. This table also shows that a 400 MW combined cycle plant would be a much cheaper alternative than a 125MW coal-fired power station. The capital cost would be the same while the cost of electricity would be $0.06 to $0.08 per kWh less. This is a quite compelling differential.

Tables 4-6 and 4-7 assume plants are operating 7,000 operating hours per year. In actuality, in a transparent free market, these plants would likely only operate at a level of 3,500 to 5,000 hours per year because the hydro power stations would consume most the load during the warmer half of the year. Because of this condition, we would expect the coal-fired power station's tariffs to increase as shown below in Table 4-8, for a 5000-hour operation condition in order to achieve the necessary rates of return.

TABLE 4-8

TARIFF IMPACT DUE TO DECREASED PLANT OPERATING HOURS

IRR(a)	Coal Price @ $30/tonne			Coal Price @ $10/tonne		
	7000 Hours	5000 Hours	Increase %	7000 Hours	5000 Hours	Increase %
15%	$0.0803	$0.1041	30%	$0.0691	$0.0930	35%
25%	$0.1189	$0.1580	33%	$0.1075	$0.1466	36%

(a) Internal Rate of Return

Table 4-8 shows the more likely case for the impact of constructing a coal-fired power station rather than a gas-fired power station. This means that the cost figures shown above can be expected to be at least 30% higher because these plants will not be operated at 7,000 hours per year. In fact, the results could be worse if the 3,500-hour operating condition exists. In our opinion, it is highly unlikely the coal-fired power plant will be able to compete in the market place.

In conclusion, we would like to point out that the proposed Tkibuli power station very likely does more economic harm to Georgia than the cost to solve the economic problems in the Tkibuli region. It is necessary to compare the costs to revitalize the Tkibuli economy to the annual costs of $35 to $61 million estimated for the higher consumer costs for the coal-fired power station. Obviously, if the plant is constructed it will cost the economy of Georgia and its citizens dearly. This solution will make products produced by Georgian entities more expensive on the international market, reduce international trade potential, and reduce the opportunity to generate hard currency. It will also unnecessarily reduce the average homeowner's purchasing power. The solution to the economic problems at Tkibuli should be addressed by properly developing economic coal markets and diversifying the economic potential in the region rather than relying upon the coal-fired power station solution. Given this analysis we believe this market be reconsidered and more economic solutions be sought.

Because of the economics of constructing a coal-fired power station, in spite of the apparent agreement to construct a coal-fired power statiou, we recommend coal industry professionals focus any new market development efforts more directly on other coal markets and invest efforts into diversifying the economic base at Tkibuli.

A report by Burns and Roe Enterprises, Inc.,[6] issued the following opinion that agrees with our assessment:

> "Thermal power has historically played a secondary role in supplying Georgia's electric energy. This trend is expected to continue until sometime after 2010. Thermal power is primarily needed to provide base load energy during the fall and winter low water seasons. However, as the availability of hydroelectric station sites that can be developed at low costs is exhausted thermal power will increase its share of total generation. At that time, gas fired combined cycle units will become the dominant technology for new plants. New gas fired combined cycle units were the only thermal technology that was found to be economical for the Georgian system. Two units of 300 and 400 MW are expected to be needed during the 2001 – 2010 period."

[6] Final Report Delivery Order No. 31 – Least Cost Plan for the Energy Sector – Georgia; Burns and Roe Enterprises, Inc., ICF Kaiser, American Electric Power, Harza Engineering Company, Center for Energy Efficiency, Submitted to the U.S. Agency for International Development, September, 1998,volume 1, chapter 1, p. 6

4.6 OTHER POTENTIAL COAL MARKETS

Other coal markets beyond the coal-fired power station existed in the past and, to some degree, have been investigated and considered by Georgian coal professionals. These other coal markets are discussed below.

4.6.1 International Coal Market

International coal market competitiveness for Tkibuli coal was determined by us by comparing Tkibuli coal to coal currently being sold on the international market. To compete on the international coal market the quality of coal and transportation costs must be considered. The best port for the export of Tkibuli coal, because of transportation and port logistics, would be the port of Poti, located in Poti Georgia. We contacted Mr. Jemal Inaishvili, General Manager of the Poti port to obtain the information in Table 4-9 relative to shipping coal through the Poti port.

Table 4-9

Poti Port Coal Transshipment Details

Maximum ship capacity	25 – 30,000 tonnes
Ship Draft Limitation	10 meters
Bosporus Straight ship capacity	100 – 150,000 tonnes
Ship unloading fee	$4.50 per tonne
Ship loading fee	$4.50 per tonne
Coal storage fee	$1.13 per month
Coal Storage Capacity	10 – 30,000 tonnes

These costs are high when compared to international rates. Generally speaking, port fees are in the neighborhood of $2.50 - $3.50 per tonne. This has the impact of making Georgian coal more expensive to export but also has the reverse effect of making coal imports more expensive. One other issue limiting the potential for coal exports and imports is the capacity of the port. With storage capacity of only 10,000 to 30,000 tonnes as well as the 30,000 tonne ship capacity limit, the international market for Tkibuli coal will be rather limited because the ship size is small. Coal exporters who can handle 100,000 to 200,000 tonne ships can harvest the lower costs of these large vessels and expand their coal market to a global dimension. Tkibuli coal, because of the ship size limitation, will have a limited market area. Meanwhile, coal imports will likely be limited to regional suppliers because of the ship size and storage limitations.

Our analysis considered prices as reported from a reputable international reporting organization[7] and represents an average of market prices for the 9 months ending March 1999. Currently, the international market is in a state of somewhat depressed market prices due to excess market supply so our analyses will reflect Tkibuli coal in a highly competitive market. Historically, the premier exporting countries include Australia, South Africa, Canada, and the United States but new producers in Indonesia, China, and South America are emerging. In the region of Georgia, Russian, Ukrainian, and FSU coal suppliers must also be considered. Table 4-10 summarizes coal prices on the international market:

Table 4-10

International Coal Market Price Indicators

Shipment Origin	Heat Content kcal/kg	Sulfur %	Ash %	Price Average $/Tonne	Price Average $/M kcal	Price Average $/M btu
United States						
Hampton Roads	7,200	1.0%	10.0%	$43.84	$6.09	$1.49
	6,950	1.0%	10.0%	$41.60	$5.99	$1.46
	6,700	1.5%	12.0%	$38.37	$5.73	$1.40
Baltimore	6,950	1.0%	10.0%	$40.02	$5.76	$1.40
	6,950	2.5%	12.0%	$36.42	$5.24	$1.28
	6,700	1.0%	12.0%	$38.96	$5.82	$1.42
	6,700	1.5%	12.0%	$35.00	$5.22	$1.27
	7,200	2.5%	10.0%	$38.24	$5.31	$1.30
Gulf Coast	6,950	1.0%	12.0%	$38.13	$5.49	$1.34
	6,700	1.5%	15.0%	$35.27	$5.26	$1.28
	6,400	1.5%	15.0%	$33.58	$5.25	$1.28
	6,300	2.2%	15.0%	$33.12	$5.26	$1.28
West Coast	6,700	0.6%	10.0%	$40.65	$6.07	$1.48
	6,400	0.7%	10.0%	$39.04	$6.10	$1.49
Canada						
Vancouver	7,200	0.7%	10.0%	$44.40	$6.17	$1.50
	6,000	0.5%	12.0%	$36.89	$6.15	$1.50
	6,000	1.0%	12.0%	$34.00	$5.67	$1.38
Poland						
Baltic Ports	7,000	0.8%	8.5%	$40.53	$5.79	$1.41
	6,700	0.8%	11.5%	$37.74	$5.63	$1.37
	6,300	0.8%	15.0%	$34.81	$5.53	$1.35
South Africa						
Richards Bay	6,400	1.0%	16.0%	$33.76	$5.28	$1.29
	6,000	1.0%	16.0%	$31.24	$5.21	$1.27

[7] Data extracted from Coal Week International, McGraw-Hill Companies, Inc., Volume 20, No. 18, May 4, 1999, p. 7.

Australia						
Newcastle	6,700	0.8%	14.0%	$37.00	$5.52	$1.35
	6,500	0.8%	14.0%	$34.58	$5.32	$1.30
	6,200	0.8%	14.0%	$31.23	$5.04	$1.23
Gladstone	6,500	0.6%	14.0%	$36.99	$5.69	$1.39
China						
Quinhuangdao	6,200	0.8%	8.0%	$34.64	$5.59	$1.36
	6,000	1.0%	12.0%	$32.89	$5.48	$1.34
Columbia						
Bolivar	6,700	0.7%	8.0%	$36.65	$5.47	$1.33
	6,550	0.8%	8.0%	$34.70	$5.30	$1.29
	6,450	0.8%	9.0%	$33.63	$5.21	$1.27
	6,300	0.8%	9.0%	$32.12	$5.10	$1.24
Europe (FOB						
ARA	6,400	1.0%	16.0%	$42.38	$6.62	$1.62
	6,000	1.0%	16.0%	$39.49	$6.58	$1.61
Russia						
Pacific	6,300	0.4%	15.0%	$33.88	$5.38	$1.31
Baltic	6,750	1.0%	16.0%	$37.22	$5.51	$1.35
	6,400	1.0%	16.0%	$35.23	$5.50	$1.34
Black Sea	6,400	0.5%	13.0%	$37.79	$5.90	$1.44
Venezuela						
Maracaibo	7,000	0.8%	7.0%	$37.50	$5.36	$1.31
Indonesia						
Kalimantan	6,700	0.8%	3.0%	$39.44	$5.89	$1.44
	6,500	0.8%	2.0%	$34.93	$5.37	$1.31
	5,200	0.1%	1.0%	$24.00	$4.61	$1.13
Math. Average	6,527	1.0%	11.5%	$36.47	$5.58	$1.36
Maximum	7,200	2.5%	16.0%	$44.40	$6.62	$1.62
Minimum	5,200	0.1%	1.0%	$24.00	$4.61	$1.13

a: Data from Coal Week International. All prices calculated on a gross as-received basis.

This information can be used to compare Tkibuli coal to prices currently being observed on the international market. The table above shows that international market prices, on an FOBT pier basis, range from a low of $4.61 to $6.62 per million kilocalories ($1.13 to $1.62 per million btu) of energy. Tkibuli coal, in order to fit within this market must then fall have the pricing constraints as shown below in Graphic 4-6.

Tkibuli coal pricing must therefore be established below the level of about $29.00 per tonne to be competitive on a free-on-board-trimmed, FOBT, basis. Because Tkibuli coal is of a much lower quality, 4,300 kcal/kg, it will incur additional penalties during the shipping from the loading port to the final destination. This analysis compares Tkibuli coal on a Free On Board, FOB, basis at the mine such that transportation and other costs must be considered. A more detailed analysis can be conducted to establish if Tkibuli coal can compete in export and import

coal markets. Table 4-11 below shows Tkibuli coal competitiveness for the export and import markets.

Graphic 4-6

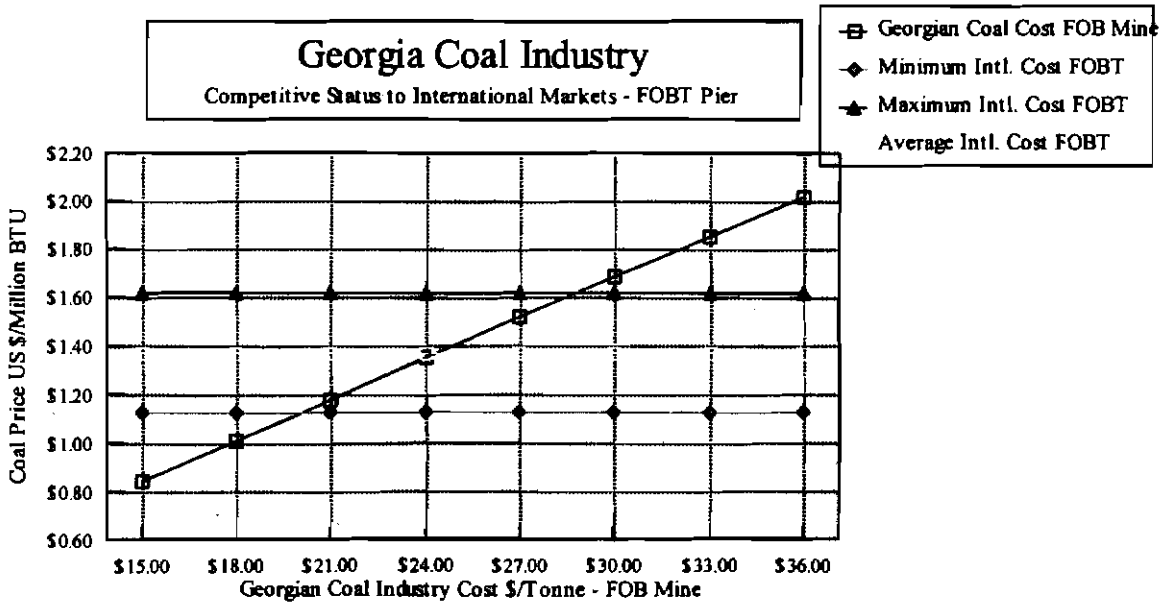

Table 4-11

International Competitiveness of Tkibuli Coal

Import Country	Region	FOBT Price US$/t	Ocean Freight & Insurance US$/t	Port & Rail Cost US$/t	Total Coal Price Delivered US$/t	As-Recd. Coal Heat Value Kcal/kg	Total Delivered Price US$/M btu	Total Delivered Price-$US /M Kcal	Rank
Australia	Newcastle or	$35.04	$9.00	$6.00	$50.04	6,475	$1.89	$7.73	7
China	Quinhuangdao	$33.76	$8.25	$6.00	$48.01	6,100	$1.92	$7.87	8
Columbia	Bolivar	$34.11	$5.60	$6.00	$45.71	6,500	$1.72	$7.03	1
Indonesia	Kalimantan	$24.09	$9.00	$6.00	$39.09	5,200	$1.83	$7.52	6
Russia	Black Sea	$37.79	$3.50	$6.00	$47.29	6,400	$1.80	$7.39	5
South Africa	Richards Bay	$32.54	$6.25	$6.00	$44.79	6,200	$1.76	$7.22	4
United States	Gulf Coast	$34.37	$6.10	$6.00	$46.47	6,550	$1.73	$7.10	2
Georgia (a)	Tkibuli	$30.00	$0.00	$1.00	$31.00	4,350	$1.74	$7.13	3
Georgia (b)	FOBT Poti	$30.00	$0.00	$9.75	$39.75	4,350	$2.23	$9.14	–

(a) Tkibuli Coal for Tkibuli Site Power Station

(b) Tkibuli Coal for export markets

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The above analysis assumes a coal-fired power station will be built within 50 kilometers of the Black Sea coast, near the Khori River, which could burn imported coal. This case is contrasted against the cost to produce and ship coal to a coal-fired power station constructed near Tkibuli. Assumed international coal prices are extracted from Table 4-10. International coals selected for this analysis are those best fitting the sulfur range exhibited by Tkibuli coals. Often the sulfur in the international coals is lower and often in the 0.80% neighborhood. In actual practice, Tkibuli coal would have to pay a price penalty because of higher sulfur in its coal.

International freight prices were determined from the referenced international coal report and assume ship capacity of up to 60,000 tonnes, which is greater than that allowable at the Poti port. Nonetheless, this analysis is intended to be indicative in nature and it is required that further in-depth analysis is necessary to produce a definitive market study. Port loading or unloading fees are estimated at $4.50 per tonne and coal import storage fees are $0.50 per tonne. Haulage distances assumed from Tkibuli to Poti port and from the Poti port to the hypothetical import coal power station are 250 and 50 kilometers, respectively. For domestic coal, this analysis assumes domestic rail transportation cost of $0.017 per tonne-kilometer for coal as derived in section 4.3. It also assumes a coal export storage fee of $1.00 per tonne due to the rail transport length differential.

The results from Table 4-11 show that Tkibuli coal could certainly compete for coal markets within Georgia and the Caucasus region. Although costs to deliver coal to Georgia appear quite competitive, the ability of the Poti port to only accept ships up to a size of 30,000 tonnes will increase delivered coal prices significantly above those projected above. It is likely that most of the potential coal importers analyzed will not be able to compete in the Caucasus market. This is important because on the Black Sea, only the port of Ilichovo in Ukraine has a slightly greater berthing depth, 12 meters. Therefore, the region south of the Caucasus range will only be a market for regional suppliers. It should be noted here that Ukraine coals are not referenced in the analysis. It is expected, because of our experience in the Ukrainian coal market, that coal produced by Ukrainians will compare equally to the Russian coal in the analysis and therefore will face the same difficult competitive conditions.

This analysis also shows Tkibuli coal will have difficulty competing on the international market beyond the Caucasus region. The calorific value of the coal is too low for the coal to bear the costs of transportation, storage, and additional handling on the way to market. The cost to get Tkibuli coal loaded aboard ship at Poti and ready for sea transportation is almost 30% higher than the likely delivered price for international coals at a prospective buyer's plant. With the calorific value of the coal at this level, Tkibuli coal can not very well compete on the international market.

We recommend Georgian coal professionals, in general, focus on a regional coal market and ignore the international coal market unless coal calorific value can be increased.

The regional international coal market consists of markets within the Caucasus region where Tkibuli coal could likely compete with any other coals being used or able to be used by

consumers. Turkey, because of its usage of high sulfur lignite coals could possibly be considered in the regional market but Tkibuli coal would have to compete directly with international coal suppliers. Therefore, this market will be difficult to penetrate. Before discarding the Turkey market, a full understanding of the ability to compete there must be developed by targeting specific plants, evaluating ports, and estimating transportation costs. Although some work has been conducted, no market assessment summaries were provided to confirm that this market should be eliminated. This market is extremely important to Georgia because sales here will generate hard currency that is badly needed in Georgia, therefore it should be evaluated in detail and efforts to increase coal heat content should certainly be investigated.

The Armenian coal market is one international market that has been supplied by Georgia in the past. This market has suffered the same consequences as in Georgia such that few sales are now being made. One major risk in doing business with Armenia, as well as other FSU entities, is getting paid for deliveries. This problem may limit the coal quantities that can be sold. This payment problem can be solved with a letter of credit, an internationally accepted payment arrangement. This market appears to be potentially attractive and should be the focus of attention by Georgian coal professionals. In a report by Hagler Bailly, Inc., [8], the author states:

> "In the past, coal accounted for less than one percent of Armenia's overall energy needs, primarily to meet seasonal demand for residential heating. Currently, coal demand has plummeted to nearly imperceptible levels. In the mid-1980s, Armenia imported between 300,000 and 400,000 tonnes of coal each year, mainly from the Donbas Basin in Russia and Ukraine. The peak year of coal imports was 1988-1989 when Armenia imported nearly 550,000 tonnes of coal. Since its peak in 1988-1989, Armenia's coal consumption has fallen to less than 5,000 tonnes per year." "Due to the "Azeri economic blockade, Armenia lost over 200,000 tonnes of coal in transit through Azerbaijan alone. Coal supplies and consumption and never recovered."

In addition to this rather large potential market, Armenia has been endeavoring to establish adequate coal reserves to allow construction of a coal-fired power station in Armenia. The purpose of the coal-fired power station would be to reduce dependence upon gas supplies. Political issues among Armenia, Azerbaijan, and Turkey threaten Armenia's gas supplies. Because of the natural gas supply issue, Armenia is in a different situation than Georgia and therefore economics have a decreased role in the decision as to what type of power station to construct. This may be a potential market for the Tkibuli coal and requires investigation by

[8] Armenia's Fossil Fuel Markets – Analysis and Recommendations to Support the Power Sector Restructuring, John Clapp, Hagler Bailly, Inc., September 1997

Georgian coal professionals and politicians. The historic size and potential of the Armenian market could mean that the minimum break-even production volumes for the Tkibuli mine complex could be achieved.

We recommend that Georgian coal professionals specifically review the potential coal markets in Armenia in an effort to solve regional issues and mutual problems.

4.6.2 Coal Gasification Combined Cycle Power Station

The consideration of the application of Tkibuli coal in a coal-gasification-combined-cycle, CGCC, power station is founded on the application of new technology that offers a greatly enhanced solution for environmental issues concerning combustion of coal. For example, a CGCC power station offers a technologic edge because plant efficiency in the range of plus 40% can now be achieved. CGCC equipment is state of the art and some CGCC technologies are just now reaching the commercial stage and are available for commercial projects.

The United States is one of the primary hotbeds for research and development of the CGCC technologies. Three types of major systems have been designed and constructed as demonstrations by the U.S. Department of Energy, DOE, in partnership with participants from the private sector. DOE reports provide the following information for the different technologies shown in Graphics 4-7 through 4-9.

These systems present a great step forward in the utilization of coal to produce electricity in an environmentally sound manner. In addition, they are significantly expanding the efficiency of coal-based plants to produce electricity. DOE provides the following opinions about the integrated-gasification-combined-cycle systems:

> "First-generation IGCC power systems capable of achieving efficiencies up to 42 percent are now at the commercial demonstration stage of development. Advanced IGCC systems demonstrated in the late 1990's will lead to commercial offerings with efficiencies of 45 percent. Technology advances such as gas turbine developments will result in further improvements, pushing system efficiencies beyond 50%." "IGCC offers low cost of electricity. The cost of IGCC-generated electricity is now competitive with the cost of electricity produced by a conventional pulverized coal plant, and by 2010 it will drop to 75% of this cost. The IGCC plant is cost-competitive to build, at a plant construction cost of $1,500 per kilowatt right now, and $1,050 per kilowatt by 2010. Costs will drop further in subsequent years."

Unfortunately, at this point in time, CGCC plants are still rather expensive, in contrast to gas fired plants. With a current cost estimated to be in the $1,500 per kilowatt, the economics of this plant would be very similar to the coal-fired conventional plant analyzed above in section 4-5.

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We recommend the IGCC be considered as an economic and environmentally friendly alternative power station technology to employ in Georgia, but are of the opinion that investors would be more prone to invest in gas-fired power stations because of the gas plant's economic advantage and readily available gas supply.

A 1999 TACIS[9] report considered IGCC systems on a smaller scale at individual industrial plants as a means to increase coal demand. They concluded:

> "These [IGCC] investments are not huge and may be accessible in Georgia. However, payback periods in relation to fuel cost savings look unattractive based on current fuel prices and Western based investment costs."

It appears, therefore that the employment of an IGCC system is too expensive for applications within Georgia because of competitive fuel options. With the available information on potential markets that could employ this type of technology, it is impossible, given limited field research, to identify the potential for this type of technology on coal demand within Georgia. It is necessary to employ a more in-depth case by case study to determine if this technology has specific potential in Georgia because of transportation cost issues and handling of coal fines. It is impossible to evaluate the cost-effectiveness of introducing IGCC technology into the Georgian economy beyond the level presented here without specific cases to evaluate. The problem here is that smaller systems will require smaller coal volumes and therefore will be incremental rather than primary markets and are therefore by their nature much more difficult to analyze for market potential.

[9] TACIS, Prospects for Use of Georgian Coal: A Brief Study by the Tacis Energy Centre, Tbilisi, 1999, p.37

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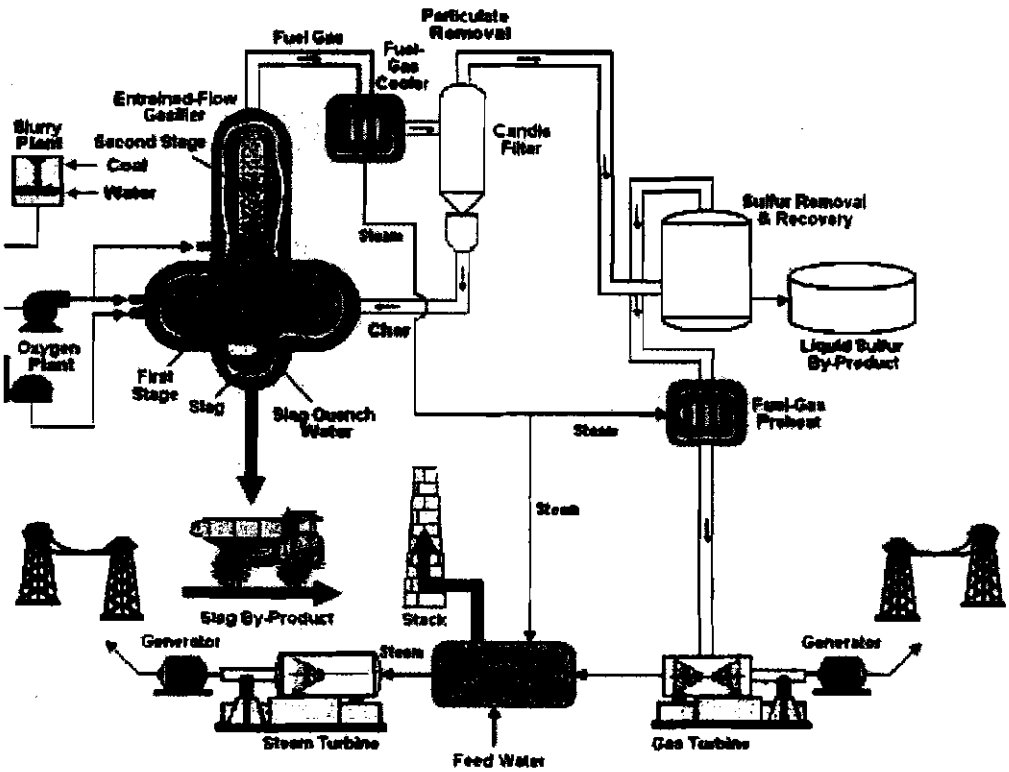
Graphic 4-7

Wabash River Coal Gasification Repowering Project

Initial Operations Date	November 1995
System Description	Two stage pressurized oxygen-blown entrained-flow IGCC
Location	West Terre Haute, Vigo County, Indiana, USA
Project Funding	$438 million
Plant Capacity	262 MW
Heat Rate Requirement	9,000 Btu/kWh (kJ/kWh)
Plant Efficiency	38%
Capital Cost / kWh	$1,672
Plant Availability	77% during late 1998



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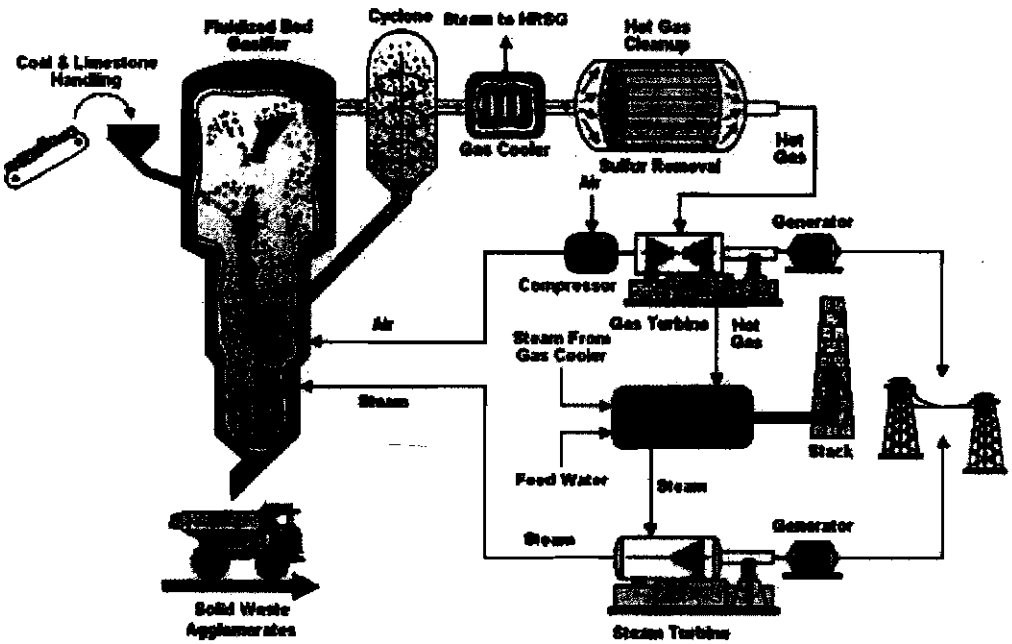
Graphic 4-8

Pinon Pine IGCC Power Project

Initial Operations Date	January 1998 (Coal Gasification)
System Description	KRW air-blown pressurized fluidized-bed IGCC
Location	Reno, Storey County, Nevada, USA
Project Funding	$335 million
Plant Capacity	99 MW
Heat Rate Requirement	7800 Btu/kWh (8190 kJ/kWh)
Plant Efficiency	44%
Capital Cost / kWh	$3,384
Plant Availability	Not available



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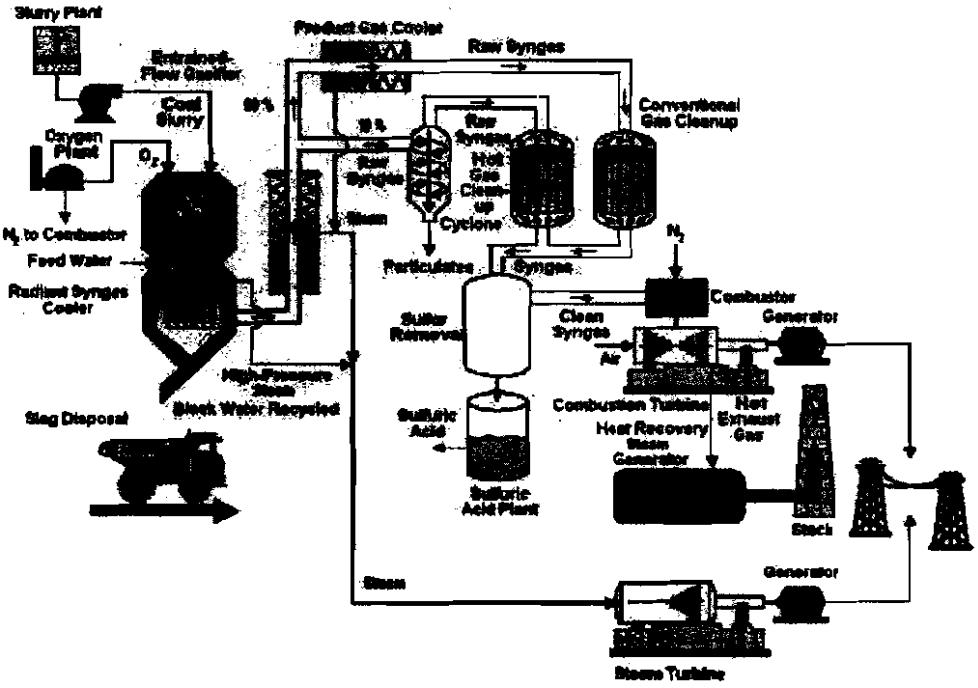
Graphic 4-9

Tampa Electric Integrated Gasification Combined-Cycle Project

Initial Operations Date	September, 1996
System Description	Uses Texaco's pressurized, oxygen-blown, entrained flow
Location	Mulberry, Polk County, Florida, USA
Project Funding	$303 million
Plant Capacity	250 MW
Heat Rate Requirement	8,600 Btu/kWh (9,030 kJ/kWh)
Plant Efficiency	40%
Capital Cost / kWh	$1,212
Plant Availability	90% since September 1997



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4.6.3 Other Coal Markets

Other markets considered for Tkibuli coal products include the markets discussed below.

4.6.3.1 Combined Heat and Power Stations

Combined heat and power, CHP, stations employed coal to produce heat and electricity in the past but these markets no longer exist. Over the past few years, these units have been badly neglected. A report by Burns and Roe Enterprises, Inc.,[10] analyzing the Georgian electricity sector reports in its findings:

> "The remainder [beyond Garbadani station] of Georgia's thermal units are in poor condition, and many are beyond repair. There is an 18 MW, three-unit, CHP plant in Tbilisi, which operates at reduced loads due to poor condition and the lack of sufficient heating load. The district heating distribution system in Tbilisi has been badly neglected and much of the equipment has been destroyed. It is questionable whether it is economical to restore the system, given the high capital cost of district heating systems and Georgia's relatively moderate heating season. A second CHP plant and district heating system in Rustavi is in worse condition."
>
> "The study evaluated the rehabilitation of existing thermal plants and found the costs to be relatively high when compared with the installation of new combined cycle units. This held true for both the larger condensing cycle units at the Gardabani Station and for the smaller CHP units. The only exception to this finding involved the possible reclaiming of one or more of the steam turbines at Gardabani. Some of the turbines from the retired units may be rehabilitated and installed in combined cycle units at a savings over the cost of new steam turbines."

It appears therefore, that little success in attracting foreign investors to restore old combined heat and power stations or to build new units will result in Georgia because of the relative economics involved.

[10] Final Report Delivery Order No. 31 – Least Cost Plan for the Energy Sector – Georgia; Burns and Roe Enterprises, Inc., ICF Kaiser, American Electric Power, Harza Engineering Company, Center for Energy Efficiency, Submitted to the U.S. Agency for International Development, September, 1998,volume 1, chapter 1, p. 7

4.6.3.2 Cement Plants

Cement plants in Georgia may show potential for future markets in Georgia. Georgia apparently has large limestone and clay resources near Kutaisi in the Terjola-Zestafoni region. There is a serious proposal to develop a cement plant put forward by F. L. Schmit of Holland and Atlas Cement of Great Britain. Discussions with experts familiar with this proposal indicate that it has merit and is worthy of consideration. This plant, according to a 1999 TACIS[11] study, would produce 800,000 to 1,200,000 tonnes of cement per year and would consume 170,000 tonnes per year of Tkibuli coal.

There is also the old Rustavi cement plant recently privatized and purchased by Interpack. Production was 87,000 tonnes in 1997 and is forecast to be 395,000 tonnes in 2002. With this older plant, one of the primary issues is whether this older technology will be competitive in the market. According to a 1998 TACIS[12] report, the market price of cement produced by Rustavi and Kaspi plants is $75 to $79 per tonne in Georgia while Kaspi's cost, FOB plant, was $78 per tonne. This report projected that if the new plant near Kutaisi were brought to fruition the cement could be "rather competitive on the local market" provided Tkibuli coal could be purchased in a price range of $40 to $42 per tonne.

Given these potential prices and current mine economics, it appears the cement industry would be a quite plausible market for Tkibuli coal. This plausibility may be even more real in the future if one considers the likely growth in the cement market to rebuild the Georgian and other Caucasus' economies. In addition, given the Black Sea port potential, the competitiveness of Georgian cement internationally may also be an unrealized potential. Unfortunately, there doesn't appear to be an evaluation of the potential of the cement market that could be employed to guide Georgian coal professionals in their consideration of potential future markets. The 1999 TACIS report referenced indicated:

> "It is not clear whether, in a free market, if [proposed cement project] will produce profitably and be able to compete with imported cement."

We recommend that Georgian coal professionals more aggressively evaluate potential Georgian, Caucasus, and international cement markets in order to evaluate the potential for Tkibuli coal use in cement production. The impact potential of coal beneficiation test results should be considered as coal market estimates are generated.

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[11] TACIS, Prospects for Use of Georgian Coal: A Brief Study by the Tacis Energy Centre, Tbilisi, 1999, p.20

[12] TACIS, Technical Assistance at Industry and Consumer Level – Exploitation of Tquibuli Coal Deposits for Power Generation and Household Needs - Technical Report, Tbilisi, 1998, p. 39-40

4.6.3.3 Other Industrial Plants and Brick Works

In the past, coal was sold to the Zestaponi metallurgical plant, and in fact very small quantities have been sold in the recent past. There have been privatization proposals for the plant that generated some hope for higher future coal sales. The problem facing Zestaponi is that there is much over-capacity for steel in the market, the competition is very stiff, the technology used at Zestaponi is rather old, and there are serious environmental issues with which a new investor must deal. Given these issues, it is our opinion that there is likely little promise for large sales potential at Zestaponi. The same assessment applies to the Rustavi metallurgical works.

Brick works, tea plants and other smaller markets have been considered in the past as markets for Tkibuli coal. Previously, some brick works were using coal but were converted during the 1970s to use natural gas instead. During the crisis period in the early 1990s, some of the plants were partially reconverted to use coal. A TACIS[13] report indicates that if all ceramic brick works were converted to use coal that the demand would be 35,000 tonnes per year. This market along with the tea market, which would also require capital investment to convert existing facilities, represent small markets which should supplement other more substantial markets necessary to support the Tkibuli coal production complex. These markets also have issues regarding coal sizing. These smaller markets are, therefore, dependent upon the primary markets necessary to support Tkibuli and should not be considered as primary markets.

We recommend the smaller markets for coal, such as the tea plants and brick works be considered as secondary coal markets that are dependent upon primary markets such as cement plant or steam coal power stations and developed in that context. Initial market development efforts therefore must be focused upon the primary markets.

4.6.3.4 Household Heat

Coal usage for household heat has been seriously considered in Georgia. It has been reported by the last referenced TACIS report (p. 42) that the "guaranteed demand of households for the Tkibuli coal is to be estimated at 70-75,000 tonnes per annum." There has been much groundwork to develop a home-heating device that could be employed within households to burn the high ash and high volatile content Tkibuli coal. Frankly, inadequate work has been conducted to evaluate these markets. Although there is much discussion about this market, there is not an adequate feasibility study which addresses the alternative fuels available to the home owner, their relative costs, capital investment costs required, incentives which could be offered by the coal producer, and environmental issues. In the information reviewed during this study,

[13] TACIS, Technical Assistance at Industry and Consumer Level – Exploitation of Tquibuli Coal Deposits for Power Generation and Household Needs - Technical Report, Tbilisi, 1998, p. 40

there did not exist an adequate summary adequately describing the distribution system necessary for the introduction of Tkibuli coal into the home market. The cost of this distribution system upon the final delivered coal price has also not been addressed. Therefore, the home fuel market can not be adequately addressed and understood.

This market may have the potential to be a major market for the Tkibuli mines. The issues of high ash and volatile content, briquette need and relative costs, heating season and any other utilization concerns need to be finalized, evaluated economically, and test marketed to a greater degree before investment or external interest can be attracted.

We recommend the home heating market be evaluated by a feasibility evaluation model with a market assessment to analyze utilization issues, test competitive fuel economics, assess environmental considerations, and test market through user surveys and other tools.

CHAPTER 5
ECONOMIC POTENTIAL OF THE COAL INDUSTRY

5.1 ECONOMIC STATUS OF THE COAL INDUSTRY

Due to the current state of the economy and the drastic decline in coal sales, the Georgian coal industry is on its heels and is facing bankruptcy. Production is almost negligible and workers are being paid very little, if any. This condition has subjected the Tkibuli region of Georgia to a severe economic hardship because the region relies so heavily upon the mining complex at Tkibuli.

Tkibuli coal is mined by underground mining methods. The coal lies within a syncline and the coal dips down on the order of 30 to 40° in the current area of mining. Coal is accessed by a 3-kilometer adit (horizontal tunnel) from the surface connected to a winze (vertical shaft) which in turn connects to further sequential mine development workings. These extensive development workings require higher tunnel maintenance due to the increasing depths below the ground surface, which, in turn, adversely impacts mining costs. As mining progresses down dip on the coal seam, the ground elevation above the coal also increases. Therefore, ground pressure on underground mine openings increases more quickly with depth and tunnel maintenance is adversely impacted. This is a natural occurrence in the mining industry. The maximum depth of mining that will be achieved at Tkibuli will be dependent upon coal quality, market conditions, mining costs, and mine conditions. Some problems we face in assessing the economic potential of the Tkibuli mines is that current reserve assessments do not provide an indication of economic reserves and market studies are inadequate to define potential coal markets.

As discussed previously, the mines are rather unique when compared to the western international mining community because they use a high level of labor to extract coal. The mines have extensive development workings now in place, some of which require refurbishment. In the future, the mines will require additional mine development workings as well as equipment to facilitate production. There are many items such as these that impact the economics of the mining operations and their potential profitability. In this section we discuss the potential of the Tkibuli mines, which represent the future potential of all coal-mining operations in Georgia.

There is an agreement to construct a coal-fired power station at Tkibuli. Although this is exactly the type of market the Tkibuli mines need to survive, we doubt that this project can compete in the transparent free market electricity system envisioned and being implemented in Georgia. In addition, if conditions in the free electricity market are restricted in order to make this proposed power station competitive, then it is our opinion that the population will pay unnecessarily and dearly for the power produced by the proposed coal-fired power station. Although we commend the Georgian coal professionals and government officials for their efforts to solve the economic

problems at Tkibuli, we are of the opinion that this is the wrong solution for the Georgian economy because it is too expensive and hardly the least cost alternative. Because of the risk identified for a potential investor in this assessment, we believe an alternative plan should be put into action, in case this agreement does not come to fruition. The discussion below presents this plan concept.

Georgian mining professionals have developed detailed plans to re-develop the mining at Tkibuli and are active in executing such plans by working to redevelop coal markets. Their state of depressed economic activity in Georgia is such that they have no potential to shut down two depleted mines that should be shut down for economic and environmental purposes. Regardless of future events, these mines need to be shut down.

5.2 ECONOMIC POTENTIAL OF THE COAL INDUSTRY

It appears the reserves necessary to sustain a mine producing 700,000 tonnes per year do likely exist. Comparison of coal classification methodologies between Georgian and United States Geological Service standards indicates the level of detail to describe coal resources are quite comparable. Although the definition of economic reserves is unanswered, the coal reserves to sustain mining at this rate for over 20 years seems quite possible.

Additional work needs to be performed to adequately establish the economic potential. For example, modern coal beneficiation studies should be conducted to determine if coal products of more value could be economically produced at Tkibuli by using western beneficiation methodology. In addition, information about the potential coal markets is not adequately described in order to establish if coal markets could be revitalized. In some cases, we have been able to establish that some markets being considered do not exist or should not be considered. Because the production potential at Tkibuli is rather small, and the Tkibuli mine complex is the only regional coal producer, a more comprehensive evaluation of market potential is necessary and may well be worth the effort. This evaluation, nonetheless, must consider the ability of coal to compete with other fuel sources, the economics to employ new combustion systems to use coal, and environmental issues.

Our economic analysis of the mining operations at Tkibuli, which is based upon Georgian economic summaries, indicates that the mines at Tkibuli do have the potential to produce a profit and be economic, given economic conditions and the existence of a potential market for the coal. The economic indicators of the current economic plan shows an after tax rate of return that ranges between 12 and 14%.

Georgian professionals are of the opinion the break-even coal production for the mine complex is about 500,000 to 600,000 tonnes per year. We are of the opinion that the breakeven analysis could benefit from several case studies performed by computer analysis rather than by hand. We are also of the opinion the potential of the Tkibuli mines could possibly be enhanced by

performing more mining and cost analyses by modern computer to enable staff and management more flexibility, speed, and creativity to evaluate mining alternatives.

We have not conducted an evaluation of the mining plans and cost projections in sufficient detail to determine if more economic methods could be used to extract the coal. In order to decrease mining costs, it is necessary to increase productivity. One method to increase productivity would be to employ a higher degree of mechanization in the excavation of coal from the face. This would likely require a modification of the mining concepts and mine plans. The mechanization potential of the coal industry could be assessed by scouting the world coal industry for similar mining conditions to ascertain what type of mining methods have been successful and how they might be employed to establish benchmarks and improve economics at Tkibuli. This concept would give the Tkibuli mines a model to follow thereby reducing their risk, rather than relying upon original mine design efforts.

The primary problem experienced at Tkibuli is the absence of a coal market. Coal markets were in decline through the 1980s and have evaporated since the FSU disintegrated and Georgia declared independence. This is the area where the most work needs to be concentrated and the most assistance is required. The concepts of marketing in a centralized government differ greatly from those in a free market system of government. Therefore, the coal professionals in Georgia have little marketing experience upon which they can rely. This is evident in the lack of quantitative marketing analysis and marketing plans as well as the lack of support for prices employed in the economic analysis. In our opinion, Georgian coal professionals still rely too much upon the Government to establish markets. This is in part due to the lack of available funds but there appears to be internal labor available who could advance marketing issues. In our view, the Georgian coal professionals require marketing training and a model to follow to conduct marketing economic evaluation.

Because the Tkibuli mines appear to have profitable potential, there is value in developing markets for the coal within the region. The Tkibuli coal mine complex is the only producer which has potential within the region south of the Caucasus to produce significant quantities of coal. The Tkvarcheli coal mine in Abkhazia may have some potential but politics prevent them from reviving the mines. The Tkvarcheli mine, although it has a higher quality coal, is rather old and has only 22 million tonnes of reserves so it is likely near exhaustion and may not be able to compete with Tkibuli mines. Our analysis has determined that very few, if any, foreign coal importers will be able to compete with Tkibuli mines. Therefore, the Tkibuli mine complex appears to have sole ownership of whatever market exists in the Southern Caucasus region.

We are of the opinion that the full potential of the coal at Tkibuli has not been adequately assessed. The processes previously employed at Tkibuli to clean the coal have a technologic age dating from the early 1950s. No work has been done to evaluate whether modern western beneficiation methodologies can economically clean the coal from ash. We are of the opinion that cost estimates expected by Georgian professionals for coal beneficiation may be quite high. We recommend that a coal-washing test, conducted by a western firm, be determined to be the top priority in establishing Tkibuli coal markets. If coal beneficiation by using new

methodologies can be much more successful than in the past then the coal market can be expanded. Possibly, some products could then be made of export grade that could earn hard cash for the Georgian economy. If coal-washing tests are successful then a feasibility study for a coal washing plant at Tkibuli should be commissioned to a highly qualified western engineering firm.

There appears to be potential in coal bed methane due to the expectation of methane reserves trapped within the coal. The potential appears to have been exploited because there is an agreement set forth with a company having coal bed methane expertise. It may be worth considering if any fees resulting from this opportunity could be employed to rebuild the Tkibuli economic community.

In short, it is not possible to produce a definitive conclusion about the economic potential of the coal industry in Georgia because of the lack of key pieces of information. One thing is certain: There is currently little active demand so new markets must be developed or old markets must be revitalized. Therefore, the potential revitalization of the Tkibuli mine complex lies at least 3 and more likely at least 5 years out in the future, in our opinion. Beyond the question of economic potential of the coal industry, because of this lag time, it is necessary to address the economic situation in the Tkibuli region by assuming there is no coal industry as well as closing the depleted mines that have no potential.

5.3 PROPOSED WORKPLAN TO BUILD A COST EFFECTIVE INDUSTRY

The mining economics provided by the Georgian coal professional appear to have potential for profit and the Tkibuli mining complex appears to be the only coal producer within the southern Caucasus region. The complex is also highly insulated from external coal competitors. There are steps that must be taken to confirm the competitiveness of Tkibuli coal as well as to enhance whatever potential may exist.

First, the potential to beneficiate the coal to produce a higher quality product by using western technology must be determined in order to establish the maximum potential and market limitations.

Second, because of the decline in regional coal demand, such as in Armenia, the regional market needs to be investigated more thoroughly to establish the potential coal market and the capability of customers to pay for coal deliveries. A detailed competitor analysis should be conducted to determine the Tkibuli coal potential beyond the southern Caucasus region. The possibility to assist in solving Armenia's natural gas supply problem by providing coal to a hypothetical Armenian coal-fired power station should be developed as an option. In addition, a detailed investigation into the requirements of the Turkish coal market should be conducted to define the minimum delivery requirements and costs, on a consumer by consumer basis, to establish competitive opportunities, especially if an enhanced coal product can be produced.

Third, work which has been performed to define regional coal markets needs to be assembled in more understandable form. Any proposals to develop coal markets need to be fully explored such that point of delivery issues, distribution systems, transportation costs, reliable demand estimates, and competitive pricing assessments are defined and analyzed in a market evaluation study which can support mine feasibility study and further market development.

Fourth, while the coal market for the Tkibuli mines are being determined, an assessment of the potential to reduce operating costs should be conducted. A global search for coal mines operating in similar geologic conditions should be conducted to determine if more mechanized coal extraction methodologies are being employed and have been proven to be acceptable. This will provide a methodology concept and the benchmark productivity criteria to possibly make Tkibuli mines more profitable. Model mines that are identified should be reviewed in detail to establish if the mining methods employed could be used at Tkibuli. Tkibuli's labor costs on an individual basis are low but the total manpower costs are a significant portion of operating expense and therefore have the potential to be optimized. Review of new mining methods, as well as efforts to simply reduce labor should defined, analyzed and employed with the goal of reducing labor costs.

The usage of computers to upgrade the analytical capability of mining staff and management should also be employed during this evaluation stage to allow quick and rapid assessment of opportunities and the development of plans. Currently, no computers are in use. Regardless of the direction of the Tkibuli mines, whether closure or continued production, at least a half dozen computers and the associated training and software would be of great value.

Fifth, once the coal market has been more reliably defined and opportunities to reduce operating costs have been evaluated, generate a clearer picture of Tkibuli mining economics and specifically determine economic mine reserves. Once the economics have been generated, the feasibility of approaching the Government of Georgia about tax deferment, reduction, or cancellation should be evaluated. If Tkibuli economics are marginal due to market or operating considerations, then it may be of value for the Government of Georgia to reduce or waive the value added tax in order to stabilize the economic community at Tkibuli and reduce economic restructuring costs in that vicinity.

Sixth, develop a new annual business plan that reflects the current situation being faced by Georgian coal professionals. Include in this plan a mission statement, a set of concrete goals, the action plans necessary to achieve these goals, and a procedure whereby achievement of goals and execution of action plans is reviewed monthly to ensure the plan is achieved.

Seventh, closure of depleted mines needs to be executed. Whether the new mines at Tkibuli can re-establish coal markets or whether the entire complex is shut down, the Tsoulikidze and Western mines need to be shut down. If the current expectation that a private investor may become responsible for the Tkibuli mine complex, then it likely will be their responsibility to shut down these two mines. Otherwise, it becomes a Georgian responsibility and the mines should be promptly closed before any environmental issues resulting from water flows from the

mine occur. If mining at Tkibuli continues, it will be economically desirable to shut these two mines down quickly in order to improve profit potential. As the shutdown plan for these two mines are considered, the actual closure activities must be separated from the mitigation of the social impacts caused by shutting them down. Request international assistance to help in closing the mines if no private investors are involved in the Tkibuli mines.

Eighth, the economic situation at Tkibuli should not rest solely upon the Tkibuli mining complex and the responsibility for the Tkibuli community should not be placed only upon Saknakshiri and Tkibulnakshiri. Tkibulnakshiri is a private company, although all shares are government owned, and should not have responsibility for the community economic woes. Otherwise, Tkibulnakshiri will not be attractive to investors and the government will not have any potential to sell shares of the company. Regardless, mitigation of the economic problems must be initiated immediately at Tkibuli by diversifying the economic base within the region. The proposals made by Saknakshiri appear to be a good start at defining opportunities but an in-depth plan is necessary and funding for this program should not be placed upon Tkibulnakshiri.

Social rehabilitation costs are the responsibility of government. Economic revitalization of the Tkibuli region should commence immediately and should not be dependent upon the fate of the Tkibuli mining complex. A plan to revitalize the Tkibuli region should be developed which is not dependent upon the Tkibuli mining complex. This plan should evaluate the potential resources existing in the area and develop ways to encourage economic revitalization. The plan should identify goals, action plans, and costs necessary to revitalize the Tkibuli region economy. In this instance there may solid value in requesting advice and assistance from the international community, because of their experience in these matters, on how to approach this problem and then how to implement a successful program.

In summary, the following is a program that should be implemented:

Proposed Tkibuli Mining Complex Work Plan to Develop a Cost Effective Industry

1. **Determine if a better coal product can be produced through coal beneficiation.**
2. **More thoroughly investigate the regional coal market and competitors.**
3. **Refine the understanding of the coal market to support re-development of the economic feasibility study.**
4. **Conduct a global review to establish if a model mine exists which could guide cost reduction efforts for the unique Tkibuli mining complex and obtain computers and training to assist in alternative cost and economic evaluations.**
5. **Redevelop mining economics to incorporate improved market intelligence and potential cost savings, and specifically determine economic mine reserves proven by**

the feasibility study. Determine whether economics are dependent upon tax incentives, and approach the Government of Georgia about tax modification, reduction, or elimination.

6. **Develop a new business plan and re-develop this plan annually.**

7. **Develop a comprehensive plan to close the depleted mines, immediately. Remove social mitigation costs from closure costs and ensure costs only reflect the true responsibility of Tkibulnakshiri. Request assistance from the international community if no private investors are involved in the project.**

8. **Transfer the responsibility for developing an economic restructuring plan for the Tkibuli region to the Government of Georgia, where it belongs, and develop a plan to mitigate economic problems in the region by revitalizing the economy with non-coal related programs. Request assistance from the international community in order to gain the rewards of their experience and assistance with these issues.**

The primary issue behind the question of economic feasibility of the Tkibuli mine complex is the difficult economic status of the Tkibuli region. The work plan proposed here should commence immediately to develop an action plan necessary to respond to the economic needs in the Tkibuli region and determine whether the Tkibuli coal mines have the potential to assist in the economic revitalization of the Tkibuli region. If a potential private investor is involved in the Tkibuli mine complex, then the effort described herein should be modified to only focus on the Tkibuli regional economic issues. The scope of work conceived herein is described above in the work recommendations which have been advised. This work plan represents a concept to hold down costs while the program is implemented by maximizing the resources of Georgian coal professionals.

The labor required for this effort requires the assistance of an international advisor to provide guidance to the Georgian coal professionals in order to direct the work activities which need to be developed, build their evaluative capacity, and analyze restructuring needs to provide more of a free market perspective. This advisor requires mining, international donor work exposure, marketing, and feasibility study experience as well as the ability to provide assistance to attract international financing assistance. It is expected this professional will work full time on this task for a full year. In addition, a full time translator/assistant will be needed. A work implementation schedule and an estimated cost is provided below:

Table 5-1

Proposed Georgian Coal Sector Economic Potential Development Work Plan

Implementation Schedule

Work Effort	Months											
	1	2	3	4	5	6	7	8	9	10	11	12
I. Fully Evaluate Georgia's Coal Resources												
1. Evaluate Coal Beneficiation Potential	X	x	x									
2. Fully investigate market and competitors	X	x	x	X	x	x	x	x				
3. Refine market assumptions to support feasibility study									X			
4. Determine if mine economics can be improved	X	x	x	X	x	x	x	x				
5. Redevelop mine economics, define economic reserves, analyze tax issues									X			
6. Develop a comprehensive plan, request assistance, and close depleted mines	X	x	x							x	X	x
7. Request economic assistance from the international community, develop a plan, and begin mitigating economic issues at Tkibuli	X	x	x	X	x	x	x	x	X	x	X	x
8. Develop a new business plan which reflects current issues	X	x	x	x								
II. Build Eveluative Capacity in Georgia Coal Enterprises	X	x	x	x	x	x	x	x	X	x	X	x
III. Restructure Georgia's Coal Sector Industries									X	x	X	x

Table 5-2

Proposed Georgian Coal Sector Economic Potential Development Work Plan

Implementation Cost Estimate

Mining, marketing, economic, and international aid liaison expert, 265 days (60% in-country).....	$265,000
Georgian interpreter/translator/assistant 265 days, (100% in-country)	$ 16,000
Per Diem and Airfare (160 days).....	$ 80,000
Miscellaneous.....	$20,000
Studies, Equipment, & Tours	
Coal Washing Study.....	$15,000
Beneficiation Feasibility.....	$50,000
Computer Equipment, Software, and Training.....	$25,000
Visit to International Mine to Reduce Operating Costs.....	$30,000
Total.....	$501,000

Note: For the purposes of this report labor rates are estimated as typical industry rates.

APPENDIX A

Useful Mineral Resource State Interministerial Commission under the State Geology Department

Classification of Solid Fossil Mining Resources and Prognosis Resources

Tbilisi, 1998

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1. General Provisions

1.1 The below described classification determines principles of calculation, evaluation and state tracking of Georgian solid fossil mining resources and prognosis resources deposited in the soil according to their economic value and researchable qualities.

1.2 Explored and economically evaluated resources are subject to state accountancy. Quantity and quality (mining-technical, hydrogeological, engineer-geologic, and other conditions) of these are approved by the Mineral Resource State Commission.

1.3 Resources are measured and tracked and the prognosis resources are evaluated according to mineral resource consistence in soil and perspectives of their potential industrial utilization.

Resources at the mines (districts) are measured on the basis of geologic-exploring and exploiting activities.

Prognosis resources are evaluated at the mines, basins, fields, regions, and deep mines derived from convenient geologic prerequisites and also through making analogues with well-known mines, geophysical and geochemical activities.

1.4 Deposited mineral resources are calculated during enrichment and concentrated reproduction performed according to the economically proved conditional[1] (exploring and exploiting) parameters set by the State Commission.

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[1] Current needs according to the stages of mine research and utilization divide conditions into exploring and exploiting.
Exploring conditions are established based on the results of different stages of mine exploration in order to determine resources and their geometrical volume.
Exploiting conditions are determined during the mine utilization planing or preparation process when it is necessary to set limited quality requirements for the extractable resources.
Note: detailed requirements, preparation, contents, main parameters, technical-economic proves of exploring and exploiting conditions are given in the special methodology handbooks.

1.5 At complex mines, resource measurement and tracking is compulsory for major and secondary useful fossil resources (metals, minerals, chemical elements and their combinations) industrial usage of which is determined appropriate by set conditions for resource measurement. Also, resources of secondary components accumulated in enriched concentrates or metallurgy reproduction products are measured and tracked in soil as well as in the above-mentioned products.

1.6 Quality of useful fossil resources is determined through a must consideration of their complex usage, technological production features, active standards and technical conditions. Consistency of useful secondary, toxic and harmful components, peculiarity of their deposit positioning and forms are simultaneously measured in enriching or factory reproduction products.

1.7 Measurement and tracking of useful fossil resources and evaluating of prognosis resources in performed using weigh or volume indicators.

1.8 Separate state tracking is provided for mining resources that are being worked on, entering exploitation, exploration, and resources that are reserved and evaluated at the mines.

1.9 Usage of the classification in relation with specific types of fossil resources is determined by normative-methodology documentation.

2. Division in Mining Groups according to Geologic Structural Integrity

2.1 **1st Group** – is mines (districts) of simple geologic structural integrity with thick or very thick, exceptionally average-sized fossil resource entities. These resources are characterized as having solid capacity, internal structure, and quality and main components are equally distributed in them; are deposited in firm or slightly faulted forms. Parallel geologic sections are single-typed. This guarantees adequate correlation of explored sections.

Peculiarities of structural integrity of a mine determine the means of exploring A, B, C_1, and C_2 resource categories and valuing P_1 category of prognosis resources.

2.2 **2nd Group** – is mines of complicated geologic structural integrity with middle and average-sized bodies that are characterized as not solid capacity and internal structure and quality or uneven distribution of main components; are deposited in faulted forms. These may have different types of parallel geologic sections and the correlation process becomes more complicated. The second group also included coal and other resources having simple geologic structural integrity that require difficult or extremely difficult mine production conditions. Peculiarities of structural integrity of a mine determine the means of exploring B, C_1, and C_2 resource categories and valuing P_1 category of prognosis resources.

2.3 **3rd Group** – is mines of extremely complicated geologic structural integrity with average and small-sized bodies that are characterized as having extremely altering capacity and internal structure and quality or distribution of main components; are deposited in torn or extremely faulted forms. The types of sections (slash, splits) vary immensely and the correlation process is very complicated. Peculiarities of structural integrity of a mine determine the means of exploring C_1, and C_2 resource categories and valuing P_1 category of prognosis resources.

2.4 **4th Group** - is small-sized mines, consisting of exceptionally small-sized bodies and deposited in very faulted forms. The capacity, internal structural integrity and quality are very altering; main components are distributed extremely unevenly. Geometry definition of a fossil resource is possible only during the production process. Peculiarities of structural integrity of a mine determine the means of exploring C_2, and sometimes C_1 resource categories and valuing P_1 category of prognosis resources.

3. Division in Mining Groups according to Geologic Structural Integrity

3.1 Useful natural resource mines are divided into explored and evaluated mines according to the degree of their study.

3.2 Explored mines are the resources quality, technological features, hydrogeologic, engineering-geologic, geo-ecological, and technical conditions of which are studied for the projects of construction or reconstruction of mining-extraction industry on their bases.

Explored mines have to fulfill the following requirements:

- Qualification of resources coincides with complexity group of a mine construction according to the categories;

- Consistence and technological features of different industrial types and sorts of useful resources is studied in details. Results of this study should be enough to project a rational technology and determine optimal alternatives of their stocking or burial or directions of usage of industrial remnants through complex extraction of useful elements.

- Other mineral resources deposited next to each other (along with their components) are studied and evaluated to the extent that is adequate for determining possible direction of their quantity and usage.

- Hydro-geologic, engineering-geologic, geo-ecological, mining-geological and other natural conditions are studied in detail as needed for preparing a draft of mine operations in accordance with the law on environmental protection and in compliance with operation safety considerations.

- Reliability of the date about the geologic structural integrity of mineral resource entities, condition of layer deposit and morphology, resource quality & quantity for the whole mine is approved for separated detailed areas. Sizes and locations of these areas are determined by the owner's taking into consideration specific geologic features of deposits.

- Parameters of exploring conditional resources are determined on the basis of technical-economic calculations. These make it possible to determine volumes of mines and their industrial importance with the adequate level of reliability.

- Mine operations' impact on the environment is discussed and recommendations on avoiding or decreasing negative natural results are provided.

3.3 Evaluated mines are the resources quality, technologic features, hydro-geologic and production mining-technical conditions of which are studied adequately to theoretically prove rationality of further exploration and production.

Evaluated mines have to fulfill the following requirements:

- Qualification of entire or part of the resource is possible under C_2 category and the prognosis resources – P_1 category;

- Consistence and technological features of resources are fully evaluated. This is needed to choose the principle scheme of production and to provide rational utilization of the resources;

- Hydro-geologic, engineering-geologic, mining-geological, geo-ecological and other natural conditions are fully studied as needed to pre –characterize their main features;

- Reliability of the data about the geologic structural integrity of mineral resource entities, condition of layer deposit and morphology, is approved for separated detailed areas.

- Parameters of calculating conditional resources are determined on the basis of broad technical-economic calculations or is determined using the analogue method (comparing similar geographic and mining-geologic conditions).

- Possible impact of mine operations on the environment is discussed and evaluated.

3.4 The soil user determines reasonable ratio of resources of different categories on the explored and evaluated mines. He is coming out from the specific geologic features of a mine, financing and mining facility construction conditions.

4. Categories of Useful Solid Fossil Resources and Prognosis Resources

4.1 According to the quality of their exploration useful solid fossil resources are divided into A, B, C_1, and C_2 Categories. According to the level of their validation proofs prognosis resources are divided into P_1, P_2, and P_3 categories.

4.2 Resources of the category A are extracted from detailed areas of 1st degree of difficulty explored mines. They fulfill the following basic requirements.

- Sizes, forms and layer conditions of useful resources are determined. Their morphology, principles of internal structural alternation and internal non-conditional areas are studied. In cases of fault the amplitude of their movement is calculated.

- Natural varieties, industrial (technological) types and qualities, their consistence and characteristics are determined. Industrial (technological) characteristics and qualities are described according to the parameters implied by the industrial requirements.

- Forms and distribution patterns of harmful and utilitarian components in the minerals and produced entities are studied.

- Contours of useful mineral resources are determined after a detailed check conducted in accordance with the conditional requirements and in accordance with drill holes and mining works.

4.3 Resources of the category B are extracted from 1st and 2nd degree explored mines and they fulfill the following requirements:

- Alternations and peculiarities of their sizes, forms and internal structural alternation are determined; Also – internal layout of non-deposit and non-conditional areas; In cases of major faults the amplitude of their movement is calculated and their condition is determined.

- Natural varieties of the resources are determined and whenever possible industrial (technological) types are contoured; If contouring is not possible then the principles of internal distribution and quantity ratio for industrial (technological) types of resources and qualities are determined. Industrial (technological) types and quantities derived from the useful resources are described in respect of every characteristic indicated by the conditions.

- Mineral forms of harmful and utilitarian components in the minerals and produced entities are studied.

- Contours of useful mineral resources are determined after a detailed check and inclusion of a limited exploitation zone; this is proved by geologic criteria, geo-physical figures and geo-chemical researches.

4.4 Resources of the category C_1 construct the mines of 1st, 2nd, and 3^{d} degreed explored mines. They also could be extracted from the detailed zones of 4th degree of difficulty mines and fulfill the following requirements:

- Resource entity sizes, characteristic form, their internal layouts and peculiarities of internal structure structural alternation are determined; Alternation of bodies and their possible faulting is evaluated.

- Natural varieties and industrial (technological) types of the resources are determined and the principles of internal distribution and quantity ratio for industrial (technological) types of resources and qualities are determined. Also, layouts of harmful and utilitarian mineral forms are studied.

- Contours of useful mineral resources are determined after a detailed check, taking into consideration the results of geophysical and geo-chemical researches and geologically proved extrapolation.

4.5 Resources of the category C_2 are extracted from mines with all levels of difficulty. They represent major part of resources at the 4th degree of difficulty mines and fulfill the following requirements:

- Resource entity sizes, characteristic form, their internal layouts and conditions of their layer deposit are evaluated by geologic and geo-physical data.

- Contours of useful mineral resources are determined according to the conditional requirements and results of checks that take into consideration geo-physical and geo-chemical researches.

4.6 Resources of complex mineral deposits and their main components are calculated in the same categories. Additional components that are industrially meaningful are calculated in the main contours of components and are qualified in categories according to their study level, distribution patterns and forms.

4.7 Mineral resources explored, extracted or present at the mines that are under development are categorized in separated groups according to their study level.

4.8 In dividing minerals into categories additional qualification indicators could be used for preciseness and liability of quantity wise and theoretical evaluation of the to-be- counted components.

4.9 Prognosis resources of the P_1 category imply the possibility of accumulation of new resources of minerals on the basis of volume increase of bodies beyond contours of C_2 category resources. They also imply the possibility of new mineral body exploration at the explored mines or the mines being under exploration. To evaluate the quality of the minerals

of this category ideas about known and well-studied mineral body sizes and their depositing conditions are used.

Evaluation of the resources is based on the results geologic, geo-physical, and geo-chemical researches.

4.10 Prognosis resources of P_2 category imply the possibility of exploration of new mines in basins, resource regions, and fields. Possible existence of such base on the explored minerals during the wide scale geologic planing and exploring activities and also geo-physical and geo-chemical anomalies that are determined to be perspective. Evaluation of resource quality, perception of possible mine sizes, consistence of minerals and their quality is based on an analogue with known, already-studied formational (genetic) types of mines. Evaluation of prognosis resources is conducted to the depth reachable for exploitation. Possible alternation of conditional parameters when comparing to the analogues mines has to be reasonably approved.

4.11 Prognosis resources of P_3 category imply exploration of different mineral resource mines but only on the basis of magmatic, stratographic, lithologic, tectonic and paleogeographic prerequisites. These are determined during initial researches at the sites, also by using pictures from outer space and on the basis of geo-chemical research results. Quality evaluation of resources included in this category is conducted without any linkage with other entities, on the basis of analogue with already studied regions that consist of similar genetic types.

4.12 Quantity evaluation of prognosis resources is conducted in a manner of complex evaluation. Requirements set toward the quality of analogue mines are used in the process and the perspectives of possible changes of the requirements are taken into consideration.

5. Groups of Useful Solid Fossil Resources According to their Economic Importance

5.1 Resources of useful components including solid useful minerals in them are divided into two groups according to their economic importance. These groups are subject to separate calculations and accounting:

Balancing (currently economic) & Non balanced (potentially economic) Reserves

Balancing resources are divided into:

a) Resources that are competent enough in the market are economically efficient and fulfill the usage and environment protection requirements.

b) Resources that are not competent and economically efficient but the extraction which is made possible by support from the government's side – subsidies, tax cuts and so on.

"Non Balanced" resources:

a) Resources that comply with the requirement set forth toward the balancing resources but the usage of is not possible due to mining- technical, legislative, ecological and other aspects.

b) Resources, extraction of which is not recommended due to low consistence of useful components, low capacity or difficult production features but usage of which is feasible for the nearest future. The economic efficiency will be raised on account of increase in the prices or technological break-through that will decrease production cost.

"Non balance" minerals are calculated and accounted under circumstances when technical-economic calculations have determined possibilities of their storage in the soil for future extraction. Another option could be simultaneous extraction followed by on-surface storage until the further utilization. When calculating "Non Balance" minerals they are divided according to the reasons why they were regarded as "non balance" resources.

5.2 Determining whether a resource is balancing or non-balanced is based on special technical-economic procedure set by the state expertise (Mineral Resources State Commission). In the

procedure there should be considered the most efficient production systems possible, its cost and in accordance with the environment protection laws.

6. Usage of the Data on Useful Mineral Resources in the Mine Industrial Utilization Process

6.1 Basis for preparing industrial plan and exploitation conditions of useful mineral resource mining is balancing resources that are approved by the State Commission (MRSC).

6.2 The following should be considered while constructing or reconstructing a mining production facility:

- Resources of all categories (balancing, as well as non-balancing) and P_1 category prognosis resources in order to anticipate perspective of production growth. Also taking into consideration the maximum depth, final contours of criteria, and facility layout.
- Extraction, usage or separate storage of collateral (secondary) useful resources deposited adjacent to the main useful resources.
- Perspective of possible extraction, usage or storage of non-balanced resources deposited alongside with the balancing resources.
- Geologic study of resources during the extraction, preparation and washing process accompanies by preparation of relevant documentation in order to improve the procedures.

6.3 Resources at the reproduction mines and exploitation conditions are subject to reconfirmation when:

- During the exploitation exploring process new types and qualities of minerals are exposed, also new approaches to usage main and collateral resources.
- Actual resources exceed approved resources by more the 50%.
- Standards and technical conditional requirements toward the quality standards of mineral resources is changing.
- Perception of natural conditions, social-economic circumstances, market, mineral resource extraction and production technology and other aspects that also cause increase (decrease) of profit by more than 20% is changed.

6.4 Tracking resource movement at the exploiting mine is to be conducted by the mining company and the data is registered at Georgian geologic funds in accordance with the Law.

6.5 Exploration and exploiting exploration should be conducted at the exploiting mines. Exploration is conducted in the areas that are not well studied (flanks, deep horizons, separate areas) in respect with mining operation development and resource extraction preparation plans. These are needed as a basis for raising resource category and calculating newly explored resources.

Exploiting exploration coincides with mining preparation and exploiting activities and comes before washing procedures. It clarifies the data on body morphology, internal structure and layer deposit conditions gathered during the detailed research.

APPENDIX B

Comparative Charts of Main Classifications of Useful Solid

Mineral Resources and Reserves

(PROVIDED BY THE GEORGIA STATE DEPARTMENT OF GEOLOGY)

Tbilisi, 1999

Chart 1

Classification of useful solid mineral resources and prognosis resources in the former Soviet Union, 1981

	Resources		Prognosis resources		
	$A+B+C_1$	C_2	P_1	P_2	P_3
Balancing	Explored resources	Pre-evaluated resources			
Non balancing					

Chart 2

International classification of UN's Economic and Social Council, 1979

	R – Total Resources r – recoverable resources		
	R-1 (r-1) – resources, deposit locations of which are determined by means of direct crust opening	R-2 (r-2) – resources, deposit locations of which is determine on the basis of analogue	R-3 (r-3) – resources, deposited in unexplored locations of geologic-industrial types
E – resources currently having economic sense to be extracted	R-1-E (r-1-E)	R-2-E (r-2-E)	
M – resources usage of which will be possible in a few years	R-1-M (r-1-M)		
S – resources usage of which is considered possible in the conceivable future	R-1-S (r-1-S)	R-2-S (r-2-S)	

Chart 3

Principles of classification of mineral resources and/or reserves by US Mining Bureau and US Geology Office, 1980

a)Basic elements of classification of mineral resources excluding reserve bases and potential reserve bases.

<table>
<tr><td rowspan="3">Cumulative

Production</td><td colspan="3">Identified Resources</td><td colspan="2">Undiscovered Resources</td></tr>
<tr><td colspan="2">Demonstrated</td><td rowspan="2">Inferred</td><td colspan="2">Probability range

or</td></tr>
<tr><td>Measured</td><td>Indicated</td><td>Hypothetical</td><td>Speculative</td></tr>
<tr><td>Economic</td><td colspan="2">Reserves</td><td>Inferred reserves</td><td colspan="2" rowspan="3">+

+</td></tr>
<tr><td>Marginally

Economic</td><td colspan="2">Marginal reserves</td><td>Inferred marginal reserves</td></tr>
<tr><td>Sub-economic</td><td colspan="2">Demonstrated</td><td>Inferred subeconomic reserves</td></tr>
<tr><td>Other occurences</td><td colspan="5">Includes nonconventional and low-grade materials</td></tr>
</table>

b) Classification of reserve bases or anticipated reserve bases.

Cumulative Production	Identified Resources			Undiscovered Resources	
	Demonstrated		Inferred	Probability range Or	
	Measured	Indicated		Hypothetical	Speculative
Economic	Reserve Base		Inferred reserve base	+	
Marginally Economic					
Sub-economic				+	
Other occurences	Includes nonconventional and low-grade materials				

Chart 4

Classification accepted by mining industries of the US and other countries

Reserves			Resources
Proved	Probable	Possible	

Chart 5

Classification of mineral resources by the Bureau of Mineral Resources,

Geology and Geophysics of Australia

		Identified resources			Undiscovered resources	
		Demonstrated				
		Measured	Indicated	Inferred	Hypothetical	Speculative
Economic					+	
Sub-economic	Para-marginal	+		+	+	
	Sub-marginal					