Comparative Analysis of Uzbekistan's Natural Gas Industry: Present Benefits and Future Costs

Bekhruz Nurnazarov

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<div style="text-align: right;">

Signed
_____
Prof. Dr. Elvan Yılmaz
Director

</div>

I certify that this thesis satisfies the requirements as a thesis for the degree of Master of Science in Economics.

<div style="text-align: right;">

Singed
_____
Prof. Dr. Mehmet Balcılar
Chair, Department of Economics

</div>

We certify that we have read this thesis and that in our opinion it is fully adequate in scope and quality as a thesis for the degree of Master of Science in Economics.

<div style="text-align: right;">

Signed
_____
Assoc. Prof. Dr. Sevin Ugural
Supervisor

</div>

Examining Committee
_____

1. Assoc. Prof. Dr. Sevin Ugural   Signed
                                          _____

2. Asst. Prof. Dr. Çağay Coşkuner   Signed
                                          _____

3. Asst. Prof. Dr. Kamil Sertoğlu   Signed

ABSTRACT

A major concern in the debate on the future of energy markets is resource scarcity. The Republic of Uzbekistan (RUz) has abundant natural gas reserves. According to BP Review (2012), the estimated value of proven reserves counted for 1841 billion metric cubes placing RUz 18th in the world. However, how to use the available natural gas reserves in future is a big challenge. Some economists argue that Uzbekistan should first of all meet domestic requirements and then export the remaining amounts, while others believe that RUz should export natural gas now and develop the natural gas field, expand it, use new innovative technology and try to increase production volumes in near future. In any case, there is reserves constraint which makes one to think of better policy so that higher return would be expected.

This paper attempted to analyze the situation from economics perspective by comparing the benefits obtained from natural gas exports in near future to the costs caused by energy import requirements in longer term, once the available natural gas reserves exhaust. For Uzbekistan, the net present value of natural gas exports should be at least equal, or greater than zero so that the economy would not suffer from current exports.

The modeled comprehensive cost-benefit analysis suggests that Uzbekistan has to continue the exports of natural gas abroad, even if it has to restrain the domestic consumption. Present benefits will surely exceed the future costs caused by importation of energy fuels in any case of demand, supply and natural gas reserve estimations. Allowing natural gas exports has the potential to help the uzbek

economy by increasing economic output of RUz and, by attracting foreign investments indeed.

ÖZ

Enerji pazarlarının günümüzdeki temel tartışma konusu kaynak kıtlığıdır. Özbekistan Cumhuriyeti doğal gaz bakımından zengin kaynaklara sahiptir. Özbekistan çeşitli BP'nin de yayınladığı raporlara göre doğal gaz sıralamasında 1841 milyar metrik küp miktarla 18. sırada yer almaktadır. Bunun yanında gelecekteki doğal gaz kullanımı ile ilgili olarak ciddi zorluklar gözlemlenmektedir. Bazı ekonomistlere göre Özbekistan ilk olarak kendi temel kullanımı için doğal gaz kaynaklarını düzenlemeli ve geri kalanını da ihraç etmelidir. Bazı ekonmistlere göreyse Özbekistan doğal gaz ihracatını şimdi gerçekleştirmeli, doğal gaz alanlarını genişletmeli ve yenilikçi teknolojiler kullanarak üretim hacmini yakın gelecekte genişletmeye çabalamalıdır. Her koşulda iki politikadan birinin (daha iyi olanının) kullanılmasını zorunlu kılan bir rezerv kısıtı söz konusudur.

Bu çalışmanın amacı ekonomik bakış açısını dikkate alarak yakın zamandaki doğal gaz ihracatlarının sağlayacağı faydayla, uzun dönemde bu kaynakların tükenmesi ve meydana gelecek ithalatın oluşturacağı maliyetleri karşılaştırmaktır. Özbekistan için doğal gaz ihracatından elde edilen net bugünkü değerin sıfırdan büyük veya eşit olması gerekmektedir. Böylece ülke ekonomisi için bir sıkıntı olmayacaktır.

Tamamlayıcı nitelikteki maliyet fayda analizimize göre Özbekistan doğal gaz ihracatına devam etmeli aynı zamanda doğal gazın ülke içerisindeki kullanımını da kısıtlamalıdır. Halihazırdaki faydalar gelecekte doğal gazla ilgili oluşacak talep arz ve ithalatın getireceği maliyetleri geçecektir. Aynı zamanda doğal gaz ihracatının

devamına izin verilmesi ekonominin büyümesine ve yabancı yatırımcıların yatırımına olanak tanıyacaktır.

Anahtar Kelimeler: Özbekistan Doğal Gaz, Maliyet Fayda Analizi, Gaz Tahmini, Gaz Ihracat, Enerji Ithalat

ACKNOWLEDGMENTS

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RUz	The Republic of Uzbekistan
LNG	Liquified Natural Gas
MMBtu	Million British thermal unit
NPV	Net Present Value
Btu	British Thermal Unit
Tcf	Trillion Cubic Feet
kWh	Kilo Watt Hour
bmc	Billion Metric Cube
cm	Cubic Meter

Chapter 1

INTRODUCTION

The Republic of Uzbekistan (RUz) is well known with its highly energy-intensive economy. Uzbekistan is the third greatest supplier of natural gas among the former Soviet Union countries, after Russian Federation and Turkmenistan. It is one of top 15 gas provider countries in the world. According to BP Review (2012), Uzbekistan's estimated proven natural gas reserves count for 1841 billion cubic metres (bmc) as of year 2012, placing it 18th in the world. However, how to use those abundant natural gas resources in future is a big challenge.

So far, RUz had been exporting its natural gas resources (at least by 2008) to Kyrgyzstan, Tajikistan, Kazakhstan, Ukraine and particularly Russia. Consequently, many researches regarding natural gas industry of Uzbekistan and Central Asia region in total have been reconciled with the assumption that the trade destination of Uzbekistan would have stayed unchanged. Meanwhile, those researches were mainly about the future forecast of trade volumes while market needs benefit-cost analysis more.

The natural gas field of Uzbekistan was found in Soviet period in 1953 and first extractions started in 1962. One of the pioneering authors in gas field, Dr. Vladimir Paramonov (February, 2008) provided a before (1991, i.e. before independence of RUz) and after analysis (up to 2008) of natural gas market of Uzbekistan. According

to his optimistic scenario results, the production volumes of natural gas in Uzbekistan would have reached its Soviet levels (e.g. 65 bmc as of 1990) in 2008 and he was almost right. According to EIA (2012), total production of natural gas in Uzbekistan was 65.2 bmc in 2007. However, the market conditions of natural gas field in the region have dramatically changed for past 5-6 years due to the increasing role of China in Central Asian natural gas market. Meanwhile, Uzbekistan's natural gas production volumes have slightly declined, 62.9 bmc as of 2012, and most importantly, there is no single export outlet to Russia anymore, which was making the regional gas resources much less worthy. "Thus far, gas resources in the region had been thought (at least by 2008) to be as just a back up to Russian supplies to Europe. However, the dynamics surrounding this region has dramatically changed and the importance of the region's gas resources is being newly highlighted." (Gi. Jung, 2008). Consequently, previous results are not reliable now and one needs to adjust them for current conditions.

This paper mainly attempts to compare the present benefits of Uzbekistan's natural gas exports to the future costs caused by energy imports for domestic market. For that purpose we construct a comprehensive model that takes into account base case information, forecasts and imposed assumptions. The imposed model is constructed in such a way that if one or more variables in table of parameters change, the whole results and implications will change accordingly. The target of model is mainly to answer the following questions at least: If the prospective domestic energy requirements of the country (at least, for next 50 years) are taken into consideration or not, will the economy of Uzbekistan be better off after meeting all export obligations, or costs will eventually exceed the benefits, should Uzbekistan export

it's natural gas reserves or not, if yes then how long it is able to? There are three main components of the model namely, domestic demand, supply and exports of natural gas. We refer to them as model parameters. However, the forecasted volumes of domestic consumption and production in previous similar studies are not reliable for this analysis due to the changed environment of natural gas market in the region. Consequently, three different scenarios of future forecast are proposed based on expected volumes of model parameters namely, low estimate, best estimate and high estimate. The main constraint of this analysis is the available natural gas reserves of RUz.

First of all, it is required to consider the available reserves of Uzbekistan as "recoverable" natural gas reserves so that it would be considered as exportable good. However, there are different approaches to such considerations due to the uncertainty of different classes of available reserves. For this analysis, we impose a commonly used standard of reserve classification approved by The Society of Petroleum Engineers (SPE) in 1997. According to that standard, the reserves can be generally divided into three main groups namely, proved, probable and possible reserves respectively. However, it is quite imprecise to measure the recoverable reserves, but they can be estimated. The imposition of deterministic figures is not a reliable method of measurement; consequently we have used the most common, probabilistic approach. Three scenarios were identified, namely, "1P" (or just "P") for low estimate, which takes into account only 90% of proved reserves; "2P" approach for best estimate, which takes 90% of proved +(plus) 50% of probable and finally "3P" approach for high estimate which adds some 10% of possible reserves to the estimated "2P".

The analysis begins by constructing a forecast of selected model parameters. The forecast of domestic demand and supply of natural gas was devoted to three main groups according to their growth rate assumptions, those are short term(2012-2016) – group01, medium term(2016-2021) – group02, and longer term (up to 2065) – group03 respectively. Annual growth rate within each group is assumed to be constant. The short and medium term results were reconciled with the results provided by BMI (2012) and considered as true values. However, according to differently expected volumes of longer term forecast, three scenarios of estimates were presented namely, low, best and high. Export volumes are held constant over time (from year 2013 perspective) due to the uncertainty of future plans of the government. However, it is also assumed that RUz will export until the available natural gas reserves fully exhaust; consequently the export volumes of natural gas are not independent of available recoverable reserves. However, it was independent in previous similar studies (e.g. Farai Kanonda, 2008).

In Republic of Uzbekistan, the production of gas is highly correlated with the production of electricity rather than oil, and it is closest substitute to coal in electricity generation projects. Moreover, electricity and heating system of Uzbekistan is the main demander of natural gas. It demanded almost 99% of total domestic consumption in 2010. Consequently benefit cost analysis (based on future approximations of supply and demand volumes) is conducted in order to compare, quantify and justify the opportunity of Uzbek gas production in coal equivalence assuming that these fossil fuels are used as inputs in electricity market. The cost-benefit analysis is carried out taking the present value today of the royalty payments that Uzbekistan receives from its sale of the natural gas resource through natural gas

exports and comparing this value to the present value of the cost of importing (or producing) the additional natural gas resources in coal equivalence in the future in order to meet its prospective domestic demand requirements.

However, there is one weakness and strength of this analysis. Even though, the comparative analysis is carried out with respect to present benefits and future costs caused by natural gas exportation, the constructed model does not provide a proper analysis of price impacts. The imposed prices, such as well-head price and export prices of natural gas are highly hypothetical. Also, it should be noted that the price of natural gas in Central Asia region is ultimately linked to the price of oil, as well as long-term contract based trade is most common. Consequently, due to the given complications of pricing issues in question, we simply preferred to hold base case price assumptions constant over time. Meanwhile, in order to see the impacts of prices in projected outcomes, sensitivity analyses have been conducted. However the sensitivity analysis just shows whether a price impacts projected outcomes, or not. It does not provide weights of impact, probabilities and ranges. The strength of the analysis is that it provides proper information of how long RUz will be able to produce and export its available, recoverable natural gas reserves under different circumstances of domestic natural gas market.

Structurally, the remaining part of this study was followed by Chapter 2 which summarizes the literature review of previous similar studies. The third chapter was separated in order to see the role and position of natural gas industry of Uzbekistan in Asia and Euro Asia region. The methodology of benefit-cost analysis of Uzbekistan's natural gas exports, as well as data and relative assumptions regarding

demand and supply volumes of domestic natural gas market were presented in chapter 4. In chapter 5 however, main concentrations were on the obtained results and implications of our analysis, also main sensitive variables as well as their impacts on projected outcomes were discussed. Projected outcomes are those main results obtained by the constructed model namely, benefits in terms of royalty payments to the government, costs in terms of future energy import requirements and contribution values of natural gas exports to the capital recovery of natural gas industry of Uzbekistan. Finally, a brief executive summary of our study was conducted in conclusion part. References and related appendices were attached in order.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, previous similar studies related to natural gas industry and energy markets in total have been briefly summarized. However, we have tried to consentrate on researches that were used in our analysis, consequently the chapter was devided based on forecast methods of selected model parameters namely, demand, supply and cost-benefit analysis of natural gas exports.

2.2 Natural Gas Demand Modeling

> "The modeling of the demand for natural gas builds on a broad arena of industry-based energy modeling... Econometric analysis, as opposed to time series approaches, has dominated much of the demand modeling literature."[1]

One of the earliest studies about extensive views of the structural determinants of energy demand was carried out by Hendrick S. Houthakker and Lester D. Taylor (1966). The study provided broad analysis and projections of consumer demand for energy market of U.S. However, this work was solely concentrated on electricity demand and it provides main background for demand determination of natural gas. However, in order to define demand for natural gas one needs to know the relationship of natural gas with electricity which is sometimes called, sister industry.

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[1] **Source:** www.psc.utah.gov/utilities/gas/05docs/05057T01/54300Appendix1.doc

In such cases, conversion factors might be used in order to approximate the volumes of demand. This is a very powerful idea if one does not hold historical data, or due to production possibilities or reserves constraint, it is impossible to determine future projections of natural gas market. We had this issue in the case of our study as well, consequently we also have tried to impose such a conversion factor in order to show natural gas volumes in an alternative energy equivalence, coal assuming that these fossil fuels are used in electricity generation projects.

There is also another way of modeling demand for natural gas market. It is based on collected data from surveys. Douglas R. Bohi and Martin B. Zimmerman (1984) provided a comprehensive survey for the determination of price elasticities. As long as price elasticities are main determinants of demand, the study provided an excellent overview for the construction of demand system for energy markets. Working with the data obtained from surveys has big drawbacks not only because of reliability of the information, but also because of econometric issues. Consequently, many researchers have suggested different types of functional forms for the demand system in order to avoid, at least reduce those drawbacks. For example, Reinhard Madlener (1996) provided a survey regarding energy demand relations. In this study, Madlener updated Bohi suggested methods by breaking the scenarios of functional forms of the model to different groups, namely log-linear and trans-log functional forms, qualitative choice and household production theory. The survey contains a discussion of the literature in empirical studies. Also, he introduces three rather recent developments in the analysis of energy demand, namely general-to specific modeling, co-integration analysis and asymmetric modeling.

Johnathan Mun (2004) describes methods of modeling solely based on past data. For investment appraisal or applied risk analysis, one needs rough estimates of required figures. If those figures are highly time depend, then one can simply regress the demand for natural gas with respect to time in order to get quick, or rough estimates of variables. The author separates a chapter for the methods of using the past data in order to predict the future. The chapter explores both time series and regression analysis in more detail through example computations. He starts with time series analysis by exploring several most common time series methods or models and describes them step-by-step. Regression analysis is then discussed, including the many pitfalls and dangers of applying regression analysis as a novice. In order to obtain rough estimates of prospective (longer term) domestic demand as well as supply of natural gas, we also applied time series forecasting methodology described in this literature for the case of Uzbekistan. By following the mentioned steps, we were able to obtain predicted values, trend as well as three scenarios of estimates (for the steps and details of estimation, refer chapter 4).

A more recent study about natural gas demand issue is provided by Howard R. Rogers (January, 2012). The study emphasizes different scenarios of Asian gas demand as well as North American gas supply over the next 15 years showing how these could create fundamentally different outcomes for European demand, supply and pricing. However, the study is about global market, it does not provide a proper analysis for the case of Central Asian Countries. The scenarios of estimate were divided into two groups based on future expectations namely, low estimate and high

estimate. Note that for the case of our analysis, we also have referred to such scenarios including best (most frequent) estimate scenario.

In general, there are quite few studies about natural gas demand in Central Asia Region, the studies have mainly been carried out with respect to supply of natural gas from the region. However, one may also assume that demand in the region can be approximated by the difference of total production and export volumes. Consequently, the supply of natural gas from the region is much more challenging.

2.3 Natural Gas Supply Modeling

One of the pioneering authors in natural gas supply modeling for the case of Central Asia region is russian economist, Dr. Vladimir Paramonov. In his studies, the author generally focuses on the energy policies, export capacities and reserves of natural gas resources, as well as regional gas transportation systems of Central Asian countries namely, Uzbekistan, Turkmenistan and Kazakhstan.

Dr. Vladimir Paramonov (2008) provides a supply forecast of natural gas from Central Asian countries for two periods, short term (2008 – 2010) and medium term (2010-2020) respectively. However, the study had been reconciled with the assumption that Uzbekistan's plans regarding natural gas exports would have remained constant in medium term (2010-2020). In the study, it is also mentioned that "Uzbekistan intended to increase its gas exports by reducing domestic consumption to an annual level of 32 billion cubic metres by the year 2020" (Sh. Kh. Mazhitov, 2006). In such a case, assuming no change in extraction volumes, the natural gas would have stayed at present levels (60 billion cubic metres as of year

2006), then Uzbekistan would be able to export about 30 bmc per annum in medium term, up to 2020.

However, du to the imposed assumptions, the figures obtained in this study are not reliable for current conditions. First of all, Russian Federation did not remain as a single outlet destination of Uzbekistan's natural gas exports. Currently RUz exports its natural gas resources to China as well. Secondly, the export capacity and production volumes are not constant. Also, Uzbekistan's proven reserves have significantly changed. Consequently, all of these factors should be taken into consideration for further projections of natural gas supply from the region. However, we still impose the similar assumptions used in this study for our own projections, but in addition we provide longer term forecast of natural gas supply based on different scenarios of estimates.

Another study in energy sector of Central Asia region was conducted by Vladimir Paramonov and Aleksey Strokov (2007) in order to provide an informative analysis of projects with the use of Russian capital. In first part of the study, authors describe the russian interest in Central Asia region in terms of extraction of hydrocarbons (mainly, natural gas) as well as the present (as of year 2007) situation of natural gas industry in Uzbekistan, Turkmenistan, Kazakhstan, Tajikistan and Kyrgyzstan. The second part of the study captures several new trends in Central Asia that could affect the Russian investment activity and projects in oil and gas field in total. According to obtained results, the interest of Russia had actively grown in energy sector of Uzbekistan, at least by the year of 2007. Total investments counted for US$ 520–1050 mln. in energy sector. However, future plans were tramendously optimistic.

"By 2012, Russia had planed to invest a suggested 4.7 to 6.2 billion dollars into the oil and gas sectors of Uzbekistan" (AIAC, 2007) for the modernization of existing infrastracture and development of geological surveys in order to define new oil and gas deposits for future projections.

Dr.Vladimir Paramonov and Dr. Aleksey Strokov (2008) have conducted a research about the trade in hydrocarbons (mainly, natural gas and oil) between Russia and Central Asian countries using an extrapolatory approach of future forecast. Extrapolation can be defined as methods that rely solely on historical data from the series to be forecasted (J. Scott Armstrong, 1984).

The table – 1 indicates the main results of analysis. Assuming that the recoverable reserves would have stayed constant over time and no global change would have happened in hydrocarbons trade conditions in Central Asia region, the three countries namely Kazakhstan, Kyrgyzstan and Tajikistan were supposed to import natural gas resources from Uzbekistan up to 7 million cubic metres in total. "Uzbekistan proposed to increase its extraction of gas by about 10% by 2020, from 60 to 65 bcm" (A. Korzhubayev, 2007) and increase the exportation volumes by at least 50 percent.

However, the conditions of natural gas trade in the region has drammatically changed by the timebeing. The two beneficier countries, Kazakhstan and Tajikistan are not even importing natural gas from Uzbekistan anymore (at least, as of year 2013). Currently, the trade destination of Uzbekistan in terms of natural gas outlays, have more consentrated on Russia, Kyrgyzstan and particularly China. Therefore, such

factors should be taken into consediration for further projections of natural gas supply from Uzbekistan.

Table 1: Central Asia (Uzbekistan, Kazakhstan, Kyrgyzstan, Tajikistan): Provisional Estimates of Volumes of Gas to be Supplied by Uzbekistan

Countries Receiving Natural Gas	Estimated supply of natural gas from Uzbekistan, millions of cubic metres		
	2010	2015	2020
Kazakhstan	2517	3414	4311
Kyrgyzstan	713	967	1221
Tajikistan	798	1082	1366
Total	**4028**	**5463**	**6898**

Source: Vladimir Paramonov and Aleksey Strokov, Russia-Central Asia: Existing and Potential Oil and Gas Trade Advanced Research and Assessment Group, UK Defence Academy, Central Asian Series 08/03, February, 2008.
Available at, mercury.ethz.ch/serviceengine/Files/ISN/.../en/08_Feb_Russia.pdf

2.4 Cost – Benefit Analysis of Natural Gas Exports

This section summarizes the similar studies of cost-benefit analysis that have been used in projection of the model for the case of Uzbekistan's natural gas market.

Gi Jung, and others (2009) provided a quantitative cost-benefit analysis which counts for the impact of legal systems, government policies and fiscal terms on a constructed hypothetical gas project which passes through Central Asian countries. The projections look like an investment appraisal, however the authors never aim to provide suggestion on investment decision making. Internal rate of return (IRR) and net present value (NPV) were the main criterions of interest.
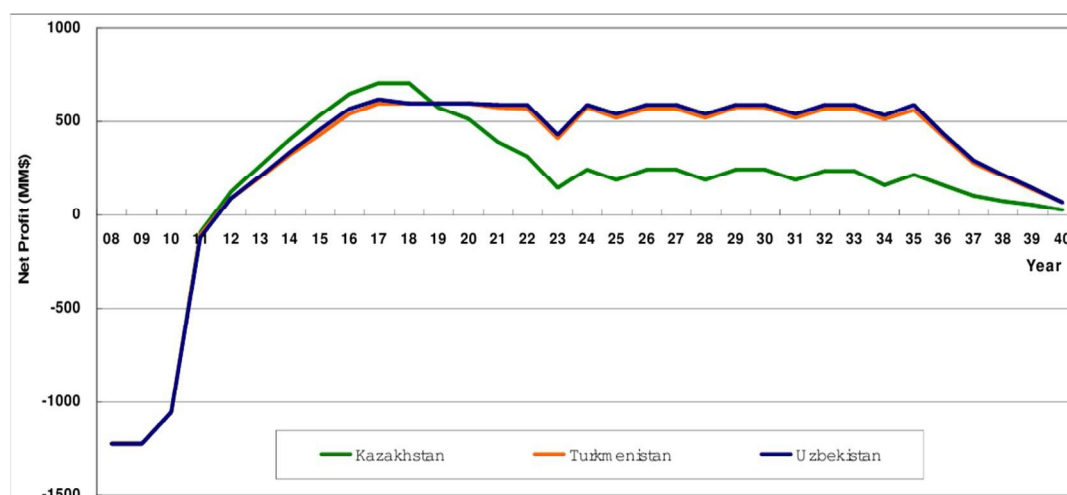
Figure 1: Flows of Net Profits.

Source: Gi Jung, Kyoung-Shik Kim, Kwang-Su Hwang: "Comparative economics of natural gas project in the Central Asian Countries: Kazakhstan, Turkmenistan, and Uzbekistan", 2009.

The figure – 1 above describes the results of analysis. Accroding to the graphical illustration of resutls, Uzbekistan best country in terms of investment decision making, however Turkmenistan is also not a bad option. However, profits from Kazakhstan are expected to peack up in near future and then ignificantly drop by 2023 and on. However, significant risk and uncertainty of future projects in question, authors also provided a sensitivity analysis of selected variables. Note that in our analysis, we also have used such an anlaysis and NPV was the preferred criterion for the cost-benefit analysis of natural gas exports of Uzbekistan.

Farai Kanonda and Glenn P. Jenkins (2008) proposed a cost-benefit analysis of lequified natural gas (LNG) exports for the case of Peru. The Republic of Peru had issued whether to implement a project for the export of LNG which would be the greatest investment decision ever, or to use the gas for future domestic consumption. It first of all depends on the opportunity cost of such exportations. In this study, the

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future oil imports were considered as an alternative option, once the available natural gas reserves of Peru fully exhaust. Consequently, future import requirements were considered as a cost. The net present value (NPV) criterion of LNG exports was the main issue of interest as it is the best criteria that answers the adressed question under scale changing sercumstances of natural gas reserves. For much of our analysis, we used the methodology proposed in this study. However, there was a need of model adjustment for the different conditions of Peru's and Uzbekistan's natural gas markets. Here are main adjustments:

(a) Domestic demand. First of all, domestic demand for natural gas in Peru was assumed to be non-restrained and they rise at higher rates compared to Uzbekistan. While, in RUz case, the domestic demand is highly restrained.

(b) Supply. There was no production possibilities constraint for Peru, it was assumed that Peru has enough capacity to produce the entire required amount of natural gas for both domestic demand and LNG exports per annum. However, in the case of RUz, there is production constraint. Even though production volumes are increasing over time, it is not enough to meet all requirements by the existing capacity. Consequently, the cosntraint has been imposed in the model.

(c) Export. The volumes of LNG export of Peru were fixed for any cases and scenarios, consequently they were independent of reserves. While, in our projections it was assumed that Uzbekistan will continue exporting natural gas resources untill it fully exhausts.

(d) Shortage. As long as Peru was able (according to the imposed assumptions) to produce all energy requirements at a time, there was obviously no extra

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need for natural gas in domestic market, consequently amount of shortage was assumed to be zero untill the reserves of natural gas are fully exhousted and Peru starts importing energy from abroad. However, due to production possibilities constraint, huge export obligations and therefore restrained demand issues, there were significant shortages expected in natural gas market of Uzbekistan.

(e) Available reserves and royalty. For the given different amounts of available reserves estimates, export volume of Uzbekistan will change due to the imposed assumption of export obligations (see part-c above). However, Peru exports are independent of reserves, consequently the value of royalty which is a measure of benefits is only related to the export quantity over the project period and is independent of the amount of available reserves. In the case of Uzbekistan, royalty payments change due to changes in available reserves accordingly.

(f) Adequacy of reserves. Too optimistic scenarios were imposed for the case of Peru regarding recoverability of available reserves. The lowest estimate was proposed to be 75% of "2P" reserves (i.e. proven + probable reserves) and 5% of the possible ones. However, the estimation method for the case of Uzbekistan was reconciled with generally applied rules by taking 90% of proven reserves for low estimate, 50% of probable ones for best estimate and 10% of possible reserves for high estimate scenarios.

(g) Estimation of model parameters. Model parameters for Peru case was based on single, deterministic values first, then sensitivity analyses were imposed accordingly. However, in our study, we investigated three scenarios of

estimation namely, low, high and best estimates respectively. Sensitivity analyses were conducted with repect to prices and discount rate.

Chapter 3

NATURAL GAS INDUSTRY OF UZBEKISTAN

3.1 Background

Oil and gas industry is one of the most important sectors of RUz economy, however Uzbekistan still benefits from the diversified economy, i.e. it is not totally dependent on energy resource flows.

On average, only an estimated 5% of total natural gas production is produced by foreign investors. Also, it should be noted that Russia had been the greatest partner in energy sector of RUz and since 2000s, the presense of offshore companies from other countries in the market have become quite often. Currently, China is also becoming one of the greatest economic partners of Uzbekistan, especially in gas field. It is demanding 10 billion cubic metres per annum which counts for about a half of total exports as of year 2013. However, the investments of China have not been used in production of natural gas yet. It seems more likely that the foreign investments in Uzbekistan's energy market, and the economy as a whole will significantly increase in near future. One example is natural gas industry, due to abunant natural gas reources and increasing exportation trends, Uzbekistan has a potential to attract huge amount of foreign investments into the country.

3.2 Natural Gas Reserves

"Uzbekistan contains substantial natural gas reserves but is currently constrained by the lack of available foreign investment and natural gas export pipeline infrastructure" (EIA, 2012). Reserves are huge, but they are uncertain in terms of recoverability. Consequently, different categories of reserves exist.

3.2.1 Classification of Reserves

Generally, the reserves are classified according to available ingeneering data and exitin geological conditions. Commonly, three classes are used namely, proven, probable and possible natural gas reserves which is approved in 1997, by The Society of Petroleum Engineers (SPE).

Speculative resources however also exist. They refer to undiscovered resources, consequently not a reliable variable for the estimation of true, recoverable reserves.

Figure − 2 below indicates the recoverability estimates of generally accepted categories of natural gas reserves. However, it is quite imprecise to measure the recoverable reserves, but they can be estimated. The imposition of deterministic figures is not a reliable method of measurement; consequently we have used a commonly used method, probabilistic approach.

Three scenarios were identified, namely, "1P" (or just "P") for low estimate, which takes into account only 90% of proved reserves; "2P" approach for best estimate, which takes 90% of proved +(plus) 50% of probable and finally "3P" approach for high estimate which adds some 10% of possible reserves to the estimated "2P". Due

to challenges in degrees of certainty associated with the estimates of natural gas resources, for our analysis, we used proved reserves as a proxy of actual reserves. probable and possible reserves were considered as prospective actual resources. Speculative resources however are not included in our model.

"Proved reserves are those reserves that can be estimated with a high degree of certainty to be recoverable" (SPEE, 2007). When deterministic methods are used, it is likely that the acually remaining recoverable quantities will exceed the estimated proved reserves. When probabilistic methods are used, there should be at least a **90%** probability that the actual quantities recovered will equal or exceed the proved reserve estimates. Currently proven reserves in Uzbekistan amounted 1841 billion cubic metres (bmc) in total, so 184.1 bmc of it is non-recoverable and the remaining part is assumed to be recoverable.

It is inherently imprecise to estimate the recoverability of probable reserves. When deterministic methods are used, the total amount of actually remaining recoverable reserves should at least equal or exceed the sum of proved amounts and probable amounts of reserves that are estimated to be recoverable. According to probabilisitic approach, 50% of probable reserves must be less than actually available, recoverable reserves, i.e. "2P" minus "1P" must be less than "2P" itself.

The recoverability estimation of possible reserves (alternatively called speculative reserves) is also inherently imprecise. When deterministic methods are used, the total volume of recoverable reserves should at least equal, or exceed the sum of proved, probable and possible amounts of recoverable natural gas reserves. According to

probabilisitic approach, 10% of possible reserves must be less than actually available, recoverable reserves, i.e. "3P" minus "2P" must be less than "3P" itself.
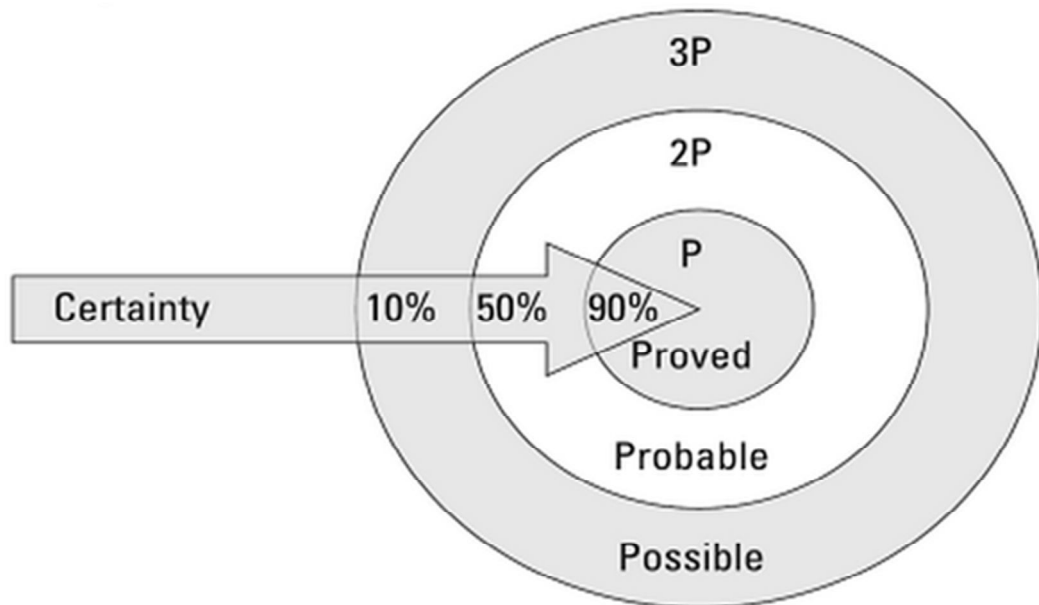
Figure 2: Reserves Categories.

Source: Vivek Chandra, "Fundamentals of Natural Gas: An International Perspective", 2006. Available at,
http://books.google.com.cy/books?id=qlw9nJ4xRjYC&pg=PA20&lpg=PA20&dq=p
roved+probable+possible+natural+gas+reserves+data&source=bl&ots=dHA_93Rha
d&sig=epb4niOHO_taK1wrRPjpAJZsUwI&hl=en&sa=X&ei=5yTXUdDaOdHCtAb
ToICwDA&ved=0CEwQ6AEwBg#v=onepage&q&f=true

3.2.2 Available Reserves in Uzbekistan

Figure – 3 denotes the top six Euroasia countries in terms of gas reserves. So, Uzbekistan is placed fourth. According to BP Review (2012), Uzbekistan's estimated proven natural gas reserves count for 1841 bmc (or 65 Tcf) as of year 2012, placing it 18th in the world.

The available natural gas resources of Uzbekistan are much higher than actual proven valumes due to the existanse of probable and possible reserves. However,

"nobody knows or can know how much natural gas exists under the earth's surface or how much it will be possible to produce in the future" (BP, 2005). Therefore, they can be only estimated.

Top Eurasia Region Gas Reserves by Country, January 1, 2012
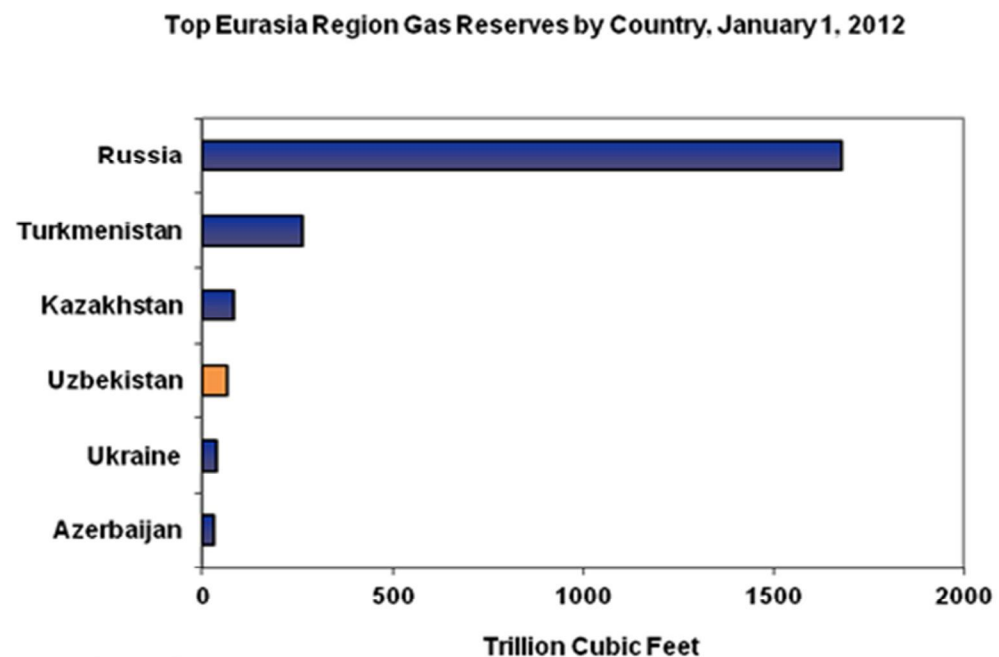
Figure 3: Top Eurasia Region Gas Reserves by Country.

Source: Energy Information Administration (EIA), Uzbekistan: Country Analysis Brief, 2012.
Available at, http://www.eia.gov/countries/cab.cfm?fips=UZ&scr=email

The expected reserves of natural gas in Uzbekistan are shown in table-2 below. It also indicates the expectation features regarding recoverability of reserves in future. Ninety percent of proven reserves is quite low estimate regarding recoverability expectations, if we add up a half of probable reserves, then it would be called best estimate which corresponds to "2P" reserves described above. High estimate however, includes some 10% of possible reserves as well ("3P" reserves). Note that, assumptions regarding the recoverability of reserves can be categorized differently

(e.g. Farai Kanonda, 2008), but for this study, there is no need of deepening such external cases.

Also note that the available reserves are adjusted on a yearly basis to account for the estimated domestic demand and prospective natural gas export obligations untill the reserves are fully exhausted. Speculative resources however were not included in the model due to the uncertainty of its existance.

Table 2: Estimated Values of Available Reserves of Natural Gas in The Republic of Uzbekistan.

Description	Bmc	Probability	Estimate
Total Proven Reserves	1841	90%	Low
Probable Natural Gas Resources	2100	50%	Best
Possible Natural Gas Resources	5900	10%	High

Sources: Uzbekistan Oil and Gas Profile Available at,
http://abarrelfull.wikidot.com/uzbekistan-oil-and-gas-profile;
Index Mundi, 2013, Available at,
http://www.indexmundi.com/g/g.aspx?v=136&c=uz&l=en;

3.3 Production volumes v.s. Available reserves

Figure – 4 below shows the comparative trend of natural gas production of Uzbekistan in Asia nad Euroasia natural gas market (Russia is excluded). Uzbekistan exported about 24% of total production in 2011, and it has an upward average trend since 1992 and holds one of key positions in Asia and Euroasia natural gas market.
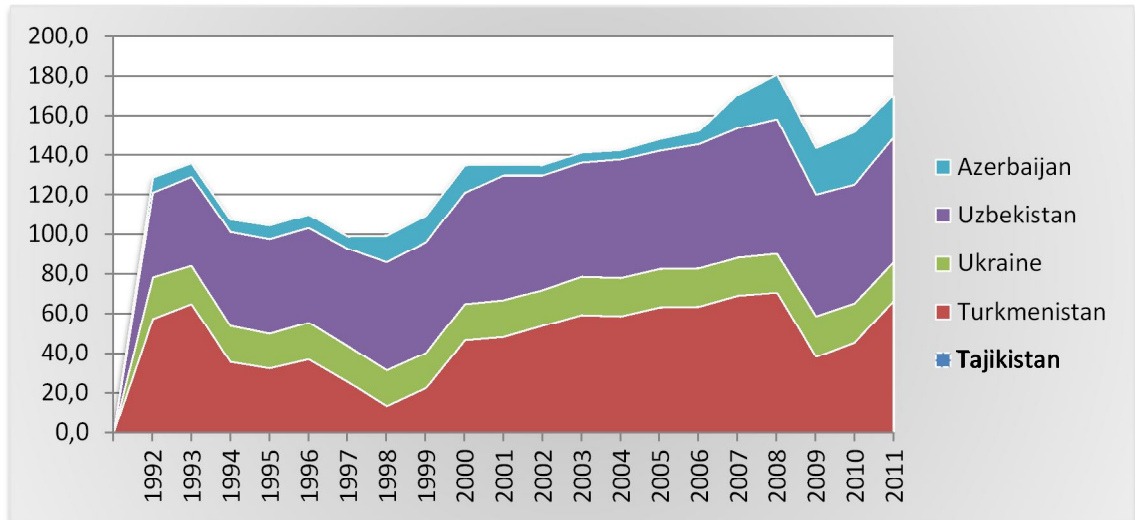
Figure 4: Natural Gas - Production (Billion Cubic Metres)

Source: The figure is authors own creation, based on data obtained from International Energy Statistics, EIA, 2012. Available at, http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=3&pid=3&aid=1&cid=AJ, RS,TI,TX,UP,UZ,&syid=1992&eyid=2011&unit=BCF

Figure – 5 below indicates the graphical illustration of the data provided by Index-Mundi (2012). It shows the trend of proven natural gas reserves. The amount of proven reserves had doubled from 2003 to 2005 and continuously decreasing over time due to domestic consumption and export obligations. However, the figures are quite low compared to total available reserves due to the existense of probable and possible reserves.
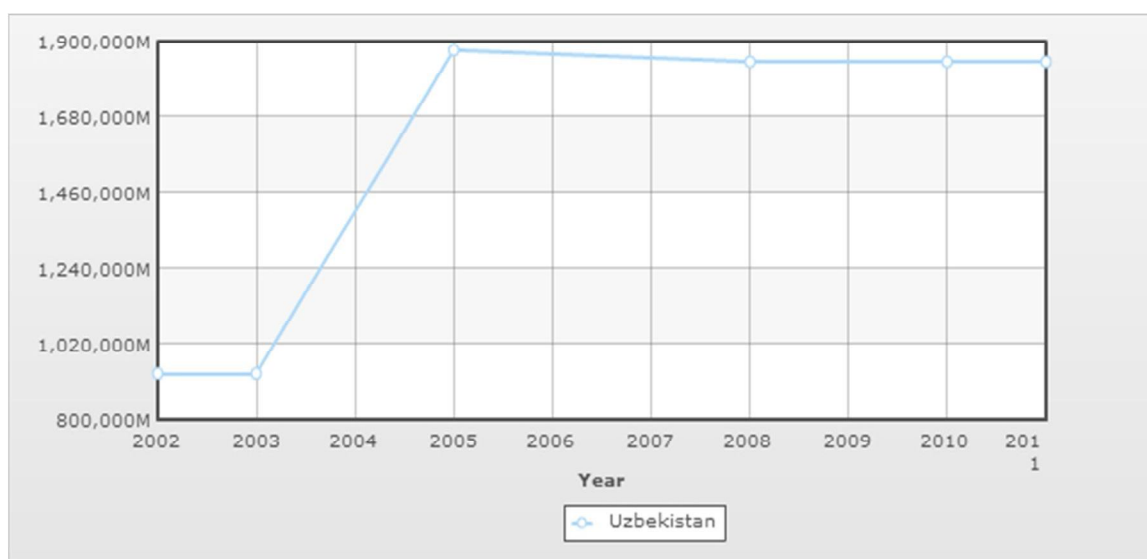
Figure 5: Natural Gas - Proved Reserves (Cubic Metres)

Source: Index Mundi, 2012
Available at, http://www.indexmundi.com/g/g.aspx?v=98&c=uz&l=en

It should be noted that production volumes are negatively related to the available natural gas reserves. As much the production is, so low the available natural gas reserves will be left for the extraction.

3.4 Natural Gas Exports.

Nearly 80 percent of total gas production is consumed by domestic demanders per annum. Domestic use of natural gas in the electric and heating sectors was about 1,600 Bcf/y in 2010, that is about 99% of total domestic consumption. At the timebeing, Uzbekistan mainly exports natural gas to Russia, 7.5 bmc and China, 10 bmc as of 2013. Some 145 million cubic metres are being exported to Kyrgyzstan as well. Exportation features are better described in section 2.2 of chapter 5.

Chapter 4

METHODOLOGY AND DATA

4.1 Introduction

In this study, we are going to conduct a cost-benefit analysis of natural gas exports for the case of The Republic of Uzbekistan (RUz). The analysis has been reconciled with past data of the years 1992 – 2012. This study is not about "before and after" or "with and without" methods. It is about present benefits and future costs. Benefits are represented by royalty payments to the government and costs are represented in terms of additional energy requirements, imports in future. The cost-benefit analysis is carried out by comparing the present value of royalty payments with future costs (in present value terms) incurred by import requirements up to the year 2065. The imposed cost-benefit analysis (or "model") must at least answer the following questions:

- If the prospective domestic energy requirements of the country (at least, for next 50 years) are taken into consideration or not;
- Will the economy of Uzbekistan be better off after meeting all export obligations, or costs will eventually exceed the benefits;
- Should Uzbekistan export its currently available natural gas reserves or not, if yes then how long it is able to?

THE PAST COMMANDS THE FUTURE! Historical data provides us with a basis for making an informed judgment about the future (J. Scott Armstrong, 1984). The main methodology that we use for the forecasts of model parameters namely, domestic demand, supply and exports of natural gas are solely based on historical data. Expert opinion however, may lead one to the conclusion that the future will be different from the past.

4.2 Model Parameters

In order to define prospective benefits and costs, it is important to know whether the natural gas resources of Uzbekistan are sufficient in terms of meeting prospective export obligations and parallelly sutisfying domestic requirements. Consequently, as the parameters of our model we consider quantities demanded and quantities supplied, as well as export volumes of natural gas.

In order to conduct a cost-benefit analysis of natural gas exports, it is first of all required to define the export capacity of RUz for the entire project profile, from 2013 up to 2065. The export capacity can be defined in two ways, one is by simply deducting the volume of domestic demand from total production (supply) volume and the other is to approximate it with the use of historica data. However, the letter method is not reliable for our analysis, due to the uncertainties of longer term plans from government perspective. Also it should be noted that, once contracts for the exports are assigned, then it becomes compulsory for the economy to export the annual volumes mentioned in the contract. Consequently, domestic demand will be restrained if production of natural gas goes below minimum requirements. However, Uzbekistan cannot produce gas infinitely due to the constrained amount of available

reserves. Therefore, the constructed comprehensive model of our analysis is subject to the available reserves constraint.

Generally, the forecast of model parameters was based on 3 groups[2] according to their growth rate assumptions, those are short term(2012-2016) – group01, medium term(2016-2021) – group02, and longer term (up to 2065) – group03 respectively.

4.2.1 Forecast of Domestic Demand and Supply

The analysis begins by constructing a forecast of the domestic demand and supply of natural gas. Short term and medium term of demand and supply forecast have been reconciled with the forecasts made by Business Monitor International (BMI).

4.2.1.1 Short Term and Medium Term Forecast

BMI reports the expected volumes of domestic demand and supply on a single, determenistic basis for the years 2016 and 2021. We consider those estimations as true values and assume that both demand and supply of natural gas in Uzbekistan will be constantly increasing within three mentioned above forecasting group categories.

Meanwhile, it is required to have annual quantites of domestic demand and supply for our analysis, consequently we need to obtain annual growth rates of model parameters untill the end of projection profile (up to 2065).

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[2] Note that the annul growth rates are the same within each group. The similar methodology was applied by Russian economist, Dr. Vladimir Paramonov (2008) for the studies of Natural Gas Markets in Central Asian Countries.

If the annual growth rates of each forecast groups (r_i) are assumed to be the same, then compounding of values to the future will be as follows:

$$q_{n_i} = q_{k_i} \cdot (1 + r_i)^{n_i - k_i}$$

where, q — quantity of model parameter (i.e. quantity demanded, supplied or export capacity); n_i— end year, k_i— beginning year of forecast group i ($i = \overline{1,3}$) and $n_i > k_i$.

As long as quantities (for first two groups only) are known, by rearranging variables we can estimate the annual growth rate for each parameter. Consequently, annual growth rate of group i is as follows:

$$r_i = \sqrt[n_i - k_i]{q_{ni}/q_{ki}} - 1$$

Also it should be noted that BMI does not provide growth rate assumptions, it provides only the end results of short term and medium term forecast. Consequently, we use those figures and apply the above mentioned formulae in order to define the annual growth rates assuming that they are constant within each period of forecast.

4.2.1.2 Longer Term Forecast

Figure – 6 below describes three different scenarios of longer term forecast. Longer term forecast (group-03) captures the years from 2021 up to 2065 (the end of projection profile). They were derived based on historical data. Three scenarious were imposed for this group, namely low, best and high estimates. Where, low

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estimate is the least expected value of a frequent volume of natural gas demanded or supplied. Best estimate is the weighted average of mid-point of all ranges and their probability of occurrence. Finally, high estimate is the maximum expected value of the frequency (solely based on historical data).
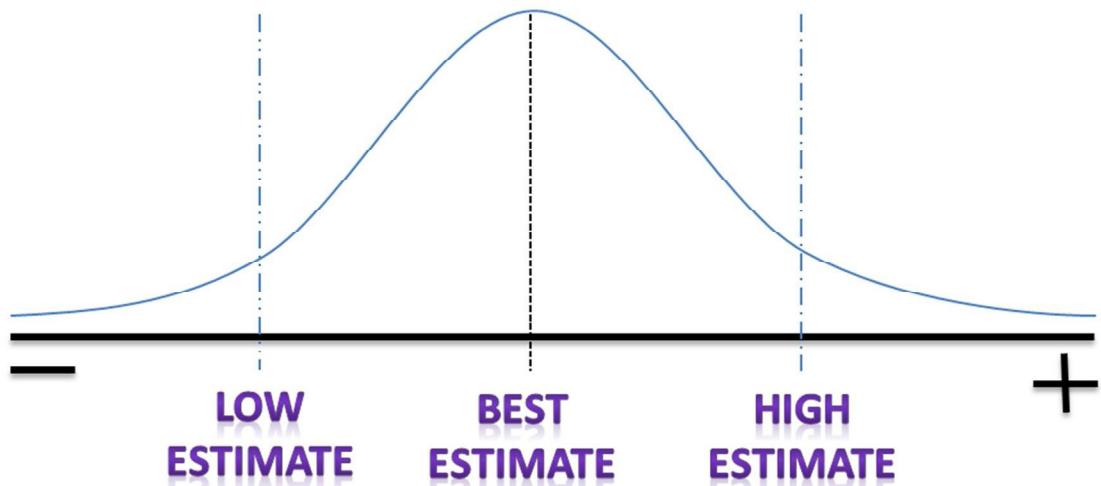
Figure 6: Three Scenarios of Forecast.

Source: Author's creation. Note that from now on, all the figures and tables are author's own creation and are constructed based on obtained resuls of analysis.

The methodology of longer term forecast is described step-by-steps below:

Step–1. Obtain historical data from related source[3] and transfer it into spreadsheet.

Step–2. Run a regression to identify a trend over years. Trend represents "predicted" values.

Step–3. Obtain residuals from regression for every year (j):

$$Residual_j = Actual_j - Predicted_j$$

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[3] The historical data for domestic production and consumption of Uzbekistan was obtained from International Energy Statistics provided by EIA, 2012. Available at, http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=3&pid=3&aid=1&cid=regions&syid=1980 &eyid=2011&unit=BCF

Step–4. Then, it is needed to convert residuals into percentage deviation:

$$Percentage\ Deviation_j = \frac{Residual_j}{Predicted_j} \cdot 100\%$$

Step–5. Define number of classes and class size. Choice of number of classes must satisfy the statistical rule:

$$\mathbf{2^k > n}$$

where, k – number of classes; n – number of observations

      i.e. 2^k must be higher than the number of observations in sample

- In our example: k = 5 and n = 21

                           2^5 = 32 which is greater than 21!

Step–6. Create a frequency distribution (Histogram) and calculate probabilities. Also note that frequency of occurrence is the number of observations in each class. After expressing frequencies as probability of occurrence, the total probability must always be 100%. Probability of occurrence represents the probability distribution of the variable.

Step–7. Finally, calulate the expected values. Expected value is a weighted average of mid-points of all ranges and their probability of occurrence.

    To calculate:

1. Find the mid-point of each range.

2. Multiply each mid-point by its probability of occurrence.

3. Sum up the results, for best estimate, for high and low estimates take maximum and minimum expected values respectively.

4.2.2 Forecast of Natural Gas Exports

Prediction of future natural gas exports of Uzbekistan is quite a challenging issue. It can not be assessed by historical lines. There have been several trials (e.g. Dr.Vladimir Paramonov and Dr. Aleksey Strokov, 2008) but currently all of those results regarding export volumes of Uzbekistan's natural gas are missleading. The main reason is probably a sharply changing economic conditions and relationships of RUz with other countries. Expert opinion is quite important for forecasting natural gas exports of Uzbekistan. For this study, we simply keep the amounts exported in 2012 constant untill available natural gas reserves are totally exhausted (B\$58\$:D\$111\$ in Appendix-1, scenario-1) . However, export conditions for China is an exception, as there is an additional gas pipeline (pipeline-3rd) with the capacity of 25 bcm is being constructed, the compleation date is end off 2015. Consequently, it is assumed that from year 2016 Uzbekistan stabilizes gas exports at 25 bmc. It is maximum capacity of the 3rd line, so there is no expected growth of supply.

It is clear that one should export if there is excess quantity supplied in the market. However, it is not such an easy task in the case of natural gas industry, especially when one is trying to make future forecasts. Once contracts for supply are assigned, it becomes compulsory for the country to meet its export obligations even while the domestic demand grows at a higher rate than expected, or production falls below minimum requirements. Consequently, the export capacity of Uzbekistan's natural gas may rise firstly, due to growing exort obligations and secondly, to expected increase of production volumes.

In order to analyze future benefits and costs of prospective natural gas exports, one needs to determine all prices, their contribution volumes and production costs. This is better illustrated in the following section.

4.3 Price Determination

In this section we investigate the methods of calculation and determination of the imposed prices and future payments.

4.3.1 Determination and Calculation of Royalty Payments

Royalty represents a payment to the government of Uzbekistan for the use of Natural Gas and expressed in percentages of well-head price per 1000 m³.

The Republic of Uzbekistan has two alternative methods of royalty computation: one is based on economic results and the other on the level of production. For this analysis it has been assumed that the royalties on natural gas exports will be based on production. This is consistent with the computation of royalties which are being paid on natural gas supplied to power plants (Farai Kanonda, 2008).

The calculation of prospective royalty payments (RP) is as follows:

$$RP_t = r \cdot P_w \cdot Q_t^S$$

Where, RP_t – royalty payment for year t (column H, excel spreadsheet-1, scenario-1); P_w – wellhead price (held constant over time) and Q_t^S– quantity supplied, representing total value of gas production (Column E, appendix-1, scenario-1). Royalty rate (r) is also held constant at the rate of r=30%.

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The Net Present Value (NPV) of royalty payments is calculated as follows:

$$NPV_t = RP_{2013} + \sum_{i=1}^{t-2013} \frac{RP_i}{(1+WACC)^i}$$

Where NPV of royalty payments (E116, Appendix-1, scenario-1) is calculated from the year 2013 perspective till t=2065, and discounted at weighted average cost of capital (WACC) as an alternative to public cost of funds (discount rates are better described in section 4.7). As the WACC is not constant over time, sensitivity analysis for this variable has been conducted in section 5.1. of chapter-5.

4.3.2 Production Costs

The capital and production expenses as well as return on the investment will be ballanced from the difference of well-head price and royalty payments, that is 70% of well-head price:

$$(1-r) \cdot P_w = (1-30\%) \cdot P_w = 70\% \cdot P_w$$

However, this is the maximum cost of natural gas production, the actual production costs are likely to be lower. Otherwise, the natural gas would not be even produced (at least, theoretically) due to exceeding costs of production over benefits. Production cost does not change over time due to constantly held royalty rate and well-head price of natural gas extracted in The Republic of Uzbekistan.

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4.3.3 Contribution of Export Price to Capital Recovery

Table – 3 below illustrates the computation of export price contribution to capital recovery. The export prices of natural gas are in U.S. dollars per thousand cubic meters and the export volumes are in million cubic meters. Prices (and price expectations) in 2012 were formed in different ways in the different regions. Because of transport costs and arbitrage between regional gas markets is not continuous, but the potential for it exists (Howard Rogers, 2010). The figures in table – 3 and further projections are represented in real terms, as of year 2013 and no flactuations are allowed as the given export prices are held constant over time.

For this study, we assume that prices are stabilized at international price level, 253 US dollars per $1000m^3$ as of year 2013 However this is a quite hypothetical figure, as prices are subject to huge flactuations with respect to time. Therefore, we have conducted a sensitivity analysis for this figure in order to see the impacts of such flactuations in projected outcomes (see, section 5.3 of chapter 5).

Contribution price determines the export price net of well-head price per 1000 cubic metres. Total value of contribution to Capital Recovery is simply contribution price times quantity of gas exported (export volume). The same methodology is used in our future projections of export values net of well-head price (column G in appendix-1, scenario-1).

Table 3: Beneficier Groups of Uzbek Gas (Excl. Domestic Consumption).

Data as of year 2013	Russia	Tajikistan	Kyrgyzistan	China
Export Price ($/1000m3)	253	0	253	253
Export Volume (million cm)	7.500	0	145	10.000
Total Revenue (million USD)	1.897,5	0	36,7	1.400,0
Contribution of Export Price to Capital Recovery (per 1000m3)	163	0	163	50
Total Value of Contribution USD	1.222.500	0	23.635	500.000

Sources: The table is authors own creation based on data provided in following links: Uzbekistan Oil and Gas Report Q1 2013 (Available at, http://www.marketresearch.com/Business-Monitor-International-v304/Uzbekistan-Oil-Gas-Q1-7288186/);

NeftegazRu, "Uzbekistan Renewed LNG exports to Russia", January 29th, 2013 (Available at, http://neftegaz.ru/news/view/107164);

Tajikistan Newswire, "Uzbekistan to cut gas to Tajikistan, reduce supplies to Russia" December 26th, 2012 (Available at, http://www.universalnewswires.com/centralasia/tajikistan/viewstory.aspx?id=13382)

The annual contribution of prospective natural gas exports to capital recovery (column G, appendix-1, scenario-1) is calculated as the summation of contribution price (P$_c$) times quantities exported:

$$CC_t = \sum_{j=1}^{4} P_{c_j} \cdot Q_{t_j}^{S}$$

where, CC_t – capital contribution value of natural gas exports per annum; P_c-contribution price, represents export price net of wellhead price which is held constant over time; $Q_{t_j}^{S}$- total quantity of natural gas supplied to a country j. We have four groups of beneficiary countries: Russia, Tajikistan, Kyrgyzstan and China. However, Tajikistan runs out of the project from 2013.

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Total value of capital contributions in present value terms as of year 2013 (E111, Appendix-1) is calculated as follows:

$$NPCV_t = CC_{2013} + \sum_{i=1}^{t-2013} \frac{CC_i}{(1 + WACC)^i}$$

or,

$$NPCV_t = CC_{2013} + \sum_{i=1}^{t-2013} \left[\frac{\sum_{j=1}^{4}(P_{c_j} \cdot Q_{t\,j}^{S})}{(1 + WACC)^i} \right]$$

where, $NPCV_t$ –is the net present value of capital contribution obtained from natural gas exports; As an alternative to private cost of funds, as a real discount rate we used weighted average cost of capital (WACC) (see section 4.7.). The results and implications are given in the next chapter.

Despite the fact that production volumes of natural gas of RUz are increasing over time, there still shortages in domestic market are expected. That is due to higher export obligations to China, and production volumes of natural gas which are not enough to meet those obligations, so one possible way is to restrain domestic consumption by imposition of surcharges or just supplying less of natural gas. In our analysis we assume that demand will be restrained due to export obligations. Consequently, export capacity will increases over time.

4.4 Estimation of Future Energy Imports

Due to high export obligations of natural gas (under the given assumptions) and gradually increasing expected volumes of shortages in domestic market, it is required to if possible produce more, if not then import additional amounts of energy from abroad.

4.4.1 Estimation of Future Natural Gas Imports

Obviously, the natural gas reserves of RUz are not infinite. The total proven recoverable reserves are counted for 1841 billion cubic meters as of year 2012. So, the supply of natural gas of RUz to both domestic and foreign consumers is subject to this constraint. This constraint is considered in the calculations of *amounts needed* to meet domestic gas demand and *quantity of required* gas imports (columns L and M respectively, appendix-1, scenario-1).

The concern of "amount needed" is domestic consumers. If proven reserves are enough to meet real domestic demand, then the value of gas needed is just a shortage obtained from the difference of total demanded and supplied volumes of natural gas in domestic market (column I less column F). Otherwise, domestic demand will not be supplied if there are no enough reserves left, consequently the value of gas needed for domestic purposes will be the shortage obtained above less value of reserves left (column L).

The concern of "quantity required" is foreign demand. If the summation of all export obligations exceeds the summation of amounts needed to meet domestic demand including existing (standpoint) year, then the quantity of required gas imports is

exactly the same as amount needed to meet domestic volume of gas demand (column M equals to column L). Otherwise, the quantity of required gas imports is just the difference of total gas export obligations with the sum of present years' quantities of natural gas required (sum of $B$68:$D$106 less sum of present years' obligations, $M$68: standpoint M). By doing so, we will provide that total volume of required natural gas will equal to total export obligations.

Note that we are trying to calculate the opportunity cost of natural gas exports which counts for 686,2 billion cubic metres (D113 in appendix-1, scenario-1)[4] in total for scenario-1, consequently it is required that the additional quantity of gas being imported is the same as total valume of natural gas being exported (i.e. D113 must be equal to M112). Total export obligations however, are not independent of available natural gas reserves. We assume that, Uzbekistan will export untill the available natural gas reserves are fully exhausted.

Once the available natural gas reserves are fully exhausted, RUz will need to import energy from abroad and this is considered as a cost in our projections. However, it is not likely that Uzbekistan can import natural gas in future in order to sutisfy the domestic needs, consequently a substitute fossil fuel has to be encountered. Generally, as cheapest substitutes for natural gas are considered oil and coal. Consequently, we need to express future natural gas imports in one of those fissil fuel equivalence, but there is no fixed conversion factor for them, as it firstly depends on where are these fossil fuels used. In energy market of RUz, the main

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[4] This volume comes from the summation of all natural gas export obligations for the entire projection profile.

demanders of natural gas are electricity generation projects and they use coal as a closest substitute for natural gas rather than oil because of resource availability issues. The estimation of conversion factor is presented in following section.

4.4.2 "Natural Gas to Coal" Conversion Factor

The comparative economics for the case of RUz is carried out with respect to coal, as it is the closest fossil fuel that is substitute for natural gas in electricity generation projects. However, there is no fixed conversion factor that represents gas in terms of coal quantities as it depends on how these fossil fuels are used in a specific industry or other sectors of economy. Usually, gas and coal are widely used in electricity generation projects as close substitutes, consequently by applying the following formula we were able to calculate the required amount of fuel in order to generate a unit of electricity:

$$\text{KWh generated per unit of fuel used} = \frac{\text{Fuel Heat Content (in Btu per physical unit)}}{\text{Heat Rate (in Btu per kWh)}}$$

Estimated value of KWh generated per unit of fuel used (conversion factors) are as follows (EIA, 2013) [5]:

1,870 kWh per Ton of Coal or 0.9 kWh per Pound of Coal

125 kWh per Mcf (1,000 cubic feet) of Natural Gas

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[5] **Source**: EIA, 2013. (http://www.eia.gov/tools/faqs/faq.cfm?id=667&t=2)

Now we can calculate the conversion factor of natural gas in coal equivalence:

$$1870 \cdot \frac{kWh}{Ton\,of\,Coal} \approx 125 \cdot \frac{kWh}{1000cf}$$

$\Rightarrow$ $1\,Ton\,of\,Coal \approx 14960\,Cubic\,Feet\,of\,Natural\,Gas$

As long as 1 Cubic Foot is 0,0283168 Metric Cube[6], the result can be shown as follows:

$$1\,Ton\,of\,Coal \approx 423{,}62\,Cubic\,Metres\,of\,Natural\,Gas$$

or, $\qquad 1000\,Cubic\,Metres\,of\,Natural\,Gas \approx 2{,}36\,Ton\,of\,Coal$[7]

Consequently, the conversion factor (CF) is:

$$CF = 2{,}36 \left(ton\,of\,coal \Big/ 1000\,cubic\,metres\,of\,natural\,gas \right)$$

4.4.3 Estimation of Future Natural Gas Imports Expressed in Coal Equivalence

Additional gas requirements represent the future Natural Gas imports and they are the sources for the calculation of costs in present value terms. Costs are represented in coal equivalences of additional natural gas requirements (column N in appendix-1, scenario-1), by simply multiplying the annual volumes (in cubic metres) of natural gas to the conversion factor represented above assuming that they are used in electricity generation projects (Column M multiplied by $C$14). Costs are expected to rise with respect to time, while benefits will decrease due to lack of natural gas

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[6] **Available at,** www.metric-conversions.org/volume/cubic-feet-conversion.htm
[7] Note that, this conversion factor is true only for electricity generation projects.

resources. One may think that if projection profile (i.e. years considered) will be extended to more years, once the costs will defenitely exceed the benefits. Well, it is true if we do not regulate the quantities projected. As long as we are conducting cost-benefit analysis of natural gas exports, the quantities exported must be exactly equal to the quantities imported in future, no matter what the assumptions are! Our model is consturcted in such a way that exportation volumes will adjust to any given reserve estimates, and quantity of impots required is explicitly reconciled with the obtained total amount of export volumes. Reserves will exhaust due to production volumes (column K depends on column E), there will be certain amount of exports due to production volumes untill the available reserves fully exhaust (columns B, C and D depend on K), finally quantities required are linked to the total volume of exports. In such a way, we provided the equalty assumption regarding export and import quantities (D113 equals to M112 in appendix-1, scenario-1).

Also note that for comparison purposes, the wellhead price of natural gas was converted explicitly and represented in coal equivalence (C5 in spreadsheet-1, scenario-1).

$$P_w^{coal} = \frac{P_w^{gas}}{CF} = \frac{50\ USD\ per\ 1000cm\ of\ natural\ gas}{2,36\ ton\ of\ coal\ per\ 1000cm\ of\ natural\ gas}$$

$$\approx 118\ {USD}/{Ton\ of\ Coal}$$

where, P_w^{coal} and P_w^{gas} are well-head prices of coal and natural gas respectively

4.6 Estimation of Future Energy Prices

The price of natural gas in Central Asia region is ultimately linked to the price of oil, and the long-term contract based trade is most common. Consequently, due to the given complications of pricing issues in question, we simply preferred to hold the base case price assumptions constant over time.

Also, there are various types of contracts exist, and they mainly differ from each other in terms of delivery obligations of suppliers. For our analysis, it is assumed that that "buyers" (foreign demanders, namely Russia, China and Kyrgyzistan) will pay 100% of total volume supplied under fixed price contract also, RUz fully meets its export obligations even if it has to restraining domestic consumption due to e.g. non-sufficient production volumes.

One weakness of this study, as it was earlier mentioned, is price issue. The imposed price figures of natural gas are highly hypothetical. In our model, export price affects only the present value of capital contribution, we discuss it in section 4.8. of this chapter. Consequently, we will impose the obtained highly hypothetical figures as deterministic values (base case scenario) then carry out a sensitivity analysis at the end. However, one of the most important variables of our model is the discount rate, as the future values have to be converted into present terms even if the real prices are held constant.

4.7 Discount Rate

Discount rate can be considered as an interest rate which investor can earn that rate in other, alternative sources. It shows the opportunity cost of investment. It i used to bring convert the future volumes into present terms.

In our calculations, a proper discount rate for prospective benefits (royalty payments) as well as expected costs (required import volumes of natural gas) is public cost of funds. However, present value of capital contribution should be discounted at the rate of private cost of funds. Note that by public cost of funds we meen the amount of government spending for financing a particular project, and private cost of funds presents the loss of private company that is financing Natural Gas Industry of RUz.

The cost of funds can be represented in dividend payments. However, due to different rates imposed in preffered and common equity in question, one can use Weighted Average Cost of Capital (WACC)[8] as a discount rate for both public and private cost of funds.

WACC is a measurement of a firm's cost of capital. WACC is assumed to be 11% and is not constant over time. Consequently, sensitivity analysis is carried out (see section 5.1. of chapter 5) for this variable.

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[8] Definition and calculation is available at, http://www.wallstreetoasis.com/finance-dictionary/what-is-weighted-average-cost-of-capital-WACC.

4.8 Benefit Cost Analysis and Net Present Value Criteria.

A surge in low-cost natural gas production of RUz has prompted a flurry of proposals to export natural gas resources. With the given assumptions of future demand and supply volumes of natural gas market of Uzbekistan, we now can undertake cost-benefit analysis of such a decision based on different scenarios.

The **well-head price** is the value natural gas at its point of production. The wellhead price has been assumed to be 50 USD per 1000 cubic meters of gas in real terms as of year 2013. It is calculated from the final sales price, after netting all expenses for services required (e.g., transportation, storage, processing and refining) to bring the gas to the point of sales. With a royalty rate of 30 percent of this price (including transportation cost), this will give an upper bound on the benefits that Uzbekistan can get from the natural gas exports.

The cost benefit analysis is carried out taking the present value today of the royalty payments and comparing this value to the present value of the cost of importing the additional fossil fuels in the future to meet its domestic demand. The same methodology was previously used by Farai Kanonda (2008).

There are several criterions that may show the results of such an analysis. However, due to problems associated with criterions in question, we need to select the best among all. The most suitable criterion for the case of this analysis was considered NPV criterion, it only needs equal timing of different scenarios. The biggest problem of alternative criterions is that they are not reliable due to changing scales. In our

analysis however, that is what we do, i.e. we obtain projected outcomes based on different scenarios of scales of production, consumption and exportation volumes.

The result of benefit-cost analysis was presented in terms of net present value of natural gas exports (F124:F127 of spreadsheet-1, scenarios 1 to 9) and is calculated by taking the difference of benefits and costs in present value terms. The following general formula was applied:

$$NPV_t^{LNG\ export} = \sum_{i=2013}^{t} \frac{RP_i - CI_i}{(1 + WACC)^{i-2013}}$$

where, RP_i – royalty payments (benefit); CI_i – coal imports (cost); WACC – weighted average cost of capital (real discount rate); i – denotes beginning year and t – end year of projection profile which are 2013 and 2065 respectively for 9 different scenarios of future expectations.

The entire methodology describtions were step-by-step reconciled with the excel spread-sheets and Appendices 1 – 9.

Chapter 5

RESULTS AND ANALYSIS

5.1 Introduction

In this chapter, the results of the forecast model are presented under three scenarios of estimation namely, low estimation, best estimation and high estimation. The results are analysed and sensitivity analysis conducted to estimate the magnitude of variability in projected outcomes.

5.2 Model Parameters

5.2.1 Forecasted Results of Domestic Demand and Supply.

In this section, the forecasted results of domestic demand and supply for short term and medium terms have been reconciled with the forcast results of BMI.

5.2.1.1 Forecasted Volumes of Short Term and Medium Term Domestic Demand and Supply

Domestic demand for natural gas in RUz is expected to rise from an estimated 46,0 bcm in 2013 to 47,4bcm in 2016, allowing for 12,2 bcm of export capacity by 2016, according to the results of short term and medium term forecast made by Business Monitor International (BMI). Consumption however, is expected to stay relatively flat, growing slowly to 49.8bcm, with net exports at about 16.8bcm by 2021 (BMI, 2013). A longer-term increase in domestic gas demand will be constrained by

Uzbekistan's export obligations, particularly to China. At forecasted levels for gas production, both domestic consumption and exports are expected to underperform real demand and capacity respectively.

Table – 4 denotes the short term and medium term annual growth rates obtained from the information above, assuming that both of quantities demanded and supplied will be changing constantly within specified periods:

Table 4: Short Term and Medium Term Annual Growth Rates.

*Demand/Supply approximations	Supply (Total volume of production)	Domestic Demand (Total volume of consumption)	Export Capacity
Total Volume (1000 m3 as of 2012)	62.911,00	48.945,00	13.966,00
Total Volume (1000 m3 as of 2013)	63.634,48	46.000,48	17.634,00
Short term annual growth rate (2012-2016)	1,15%	1,00%	1,67%
Medium term annual g rowth rate (2016-2021)	2,00%	0,70%	7,40%

Domestic demand for year 2012 was obtained by subtracting the total volume of export obligations from the supply. However, actual demand of natural gas might be quite different from the denoted 48.9 billion cubic meters as consumers might have substituted natural gas to other fuels because of restrained demand. We are more concerned with the figures of year 2013 as our projections start from that period. In order to avoid such challenges, we simply start the projections with 46 bmc of domestic demand reported by BMI, considering this figure as true value. So according to results, in short term demand and supply are expected to grow at 1% and 1.15% levels per annum respectively. However, in medium term domestic demand is expected to slowdown in terms of annual growth rates to 0.70% while production volumes are expected to grow even faster instead, at least 2%.

5.2.1.2 Longer Term Forecast of Domestic Demand

One can consider the historical trend of natural gas consumption as a proxy of demand in domestic market. The longer term forecast for the market was reconciled with the steps mentioned in chapter four. By longer term forecast, we mean projection of model parameters from 2021 up to end of projection profile, 2065.

Table – 5 represents the comparison of actual volumes of domestic natural gas demand, and predicted figures based on historical data for the years 1992-2012. The annual residual terms are just the difference of actual and predicted volumes of natural gas consumption. Now, we devide annual residual terms by predicted volumes. By doing so, we were able to calculate the percentage deviation of predicted figures from historical volumes. This steps of analysis are important for the determination of main indicators for longer term forecast. The sample size of our observation is n=21. The minimum and maximum values of percentage deviations are -16.39% and 15.39% respectively, consequently total range is 31.78% (=15.39%-(-16.39%)). The number of classes as it was calculated earlier, is k=5. Consequently, the range of classes size is 6.36% (= 31.78%/5).

Table 5: Comparison of Actual and Predicted Volumes of Domestic Natural Gas Demand.

Year	Domestic Demand	Predicted	residuals	% Deviation
1992	31.006.896	37.085.647	- 6.078.751	-16,39%
1993	43.636.189	37.816.357	5.819.832	15,39%
1994	34.801.347	38.547.067	- 3.745.720	-9,72%
1995	38.199.363	3.927.778	- 10.784	-0,27%
1996	40.606.291	40.008.488	5.978.033	14,94%
1997	41.200.944	40.739.198	4.617.462	11,33%
1998	39.898.371	41.469.908	- 1.571.537	-3,79%
1999	40.294.806	42.200.618	- 190.581	-0,45%
2000	42.786.685	42.931.328	- 1.446.433	-3,37%
2001	45.193.613	43.662.038	1.531.575	3,51%
2002	46.496.186	44.392.749	2.103.437	4,74%
2003	47.289.056	45.123.459	2.165.597	4,80%
2004	50.205.686	45.854.169	4.351.517	9,49%
2005	48.195.194	46.584.879	1.610.315	3,46%
2006	50.092.419	47.315.589	2.776.830	5,87%
2007	50.488.854	48.046.299	2.442.555	5,08%
2008	52.612.614	48.777.010	3.835.604	7,86%
2009	46.213.018	49.507.720	- 3.294.702	-6,65%
2010	45.703.315	50.238.430	- 4.535.115	-9,03%
2011	51.026.874	50.969.140	5.773.394	11,33%
2012	48.945.000	51.699.850	- 5.399.850	-10,44%

Now, we can obtain frequency distribution for our data. The results are presented in table – 6. According to expected growth rate volumes of future natural gas demand, the best estimate which is weighted average of all ranges and probabilities of occurance is 2%.

Table 6: Frequency Table of Domestic Natural Gas Demand.

№	Min	Max	Mid point	Frequency	Probability	Expected
1	-16,39%	-10,03%	-13,21%	2	9,52%	-1,26%
2	-10,03%	-3,68%	-6,86%	4	19,05%	-1,31%
3	-3,68%	2,68%	-0,50%	3	14,29%	-0,07%
4	2,68%	9,03%	5,86%	7	33,33%	1,95%
5	9,03%	15,39%	12,21%	5	23,81%	2,91%
			Total	21	100%	2%

Low estimate is the minimum expected value, so it is -1,31% (negative). That means, under low estimation the demand for natural gas in domestic market will actually fall in longer term. According to high estimates, it will grow at almost 3% instead.

Figure – 7 presents the graphical illustration of the obtained results under three diffeent scenarios. According to low estimate, the demand will significantly drop in short period, from 2014 to 2016 then gradually starts increasing in medium term. A flatter curve is realized in longer term growth rate, after 2021. However, both low and high estimates show that domestic demand for natural gas will rise gradually all over projection profile.

Note that on vertical axis the expected volumes of demand are represented and the years on horizontal axis. From the diagram, it can be realized that domestic demand under low estimate is relatively flatter and is not exceeding 60 billion cubic metres, while high estimate already exceeds that in year 2028. It also should be noted that the future trend of demand for natural gas mostly depends on prospective real GDP fluctuations of RUz and population growth rates. Our analysis however, is solely based on historical data, so it should be taken into consediration while making any decision regarding the prospective demand volumes.
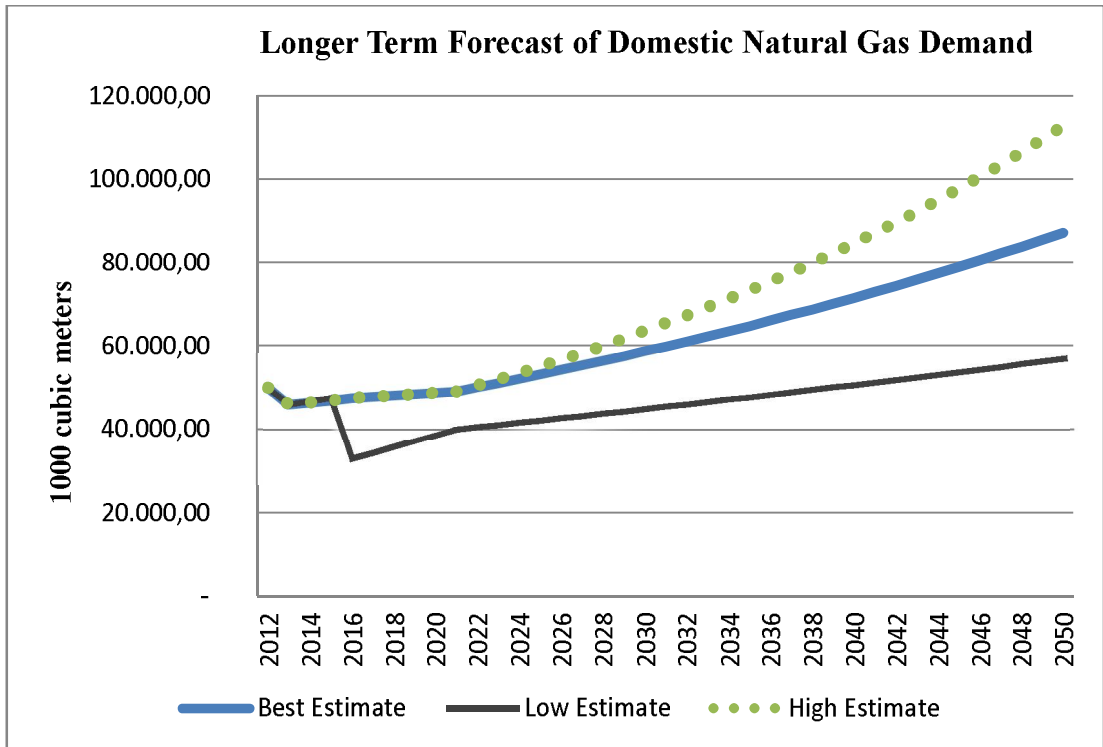
Figure 7: Longer Term Forecast of Domestic Natural Gas Demand in Energy Market of RUz.

5.2.1.3 Longer Term Forecast of Supply

The historical trend of total volumes of production was considered as a proxy of natural gas supply in energy market of Uzbekistan. The results of trend comparison with actual values is presented in table – 7 below. Generally trend is going upwards with respect to time, consequently one can expect growth in production volumes in future, also residuals are relatively less compared to demand case, leading actual values to be less deviated from the predicted values (or the trend).

Table 7: Comparison of actual and predicted volumes of natural gas supply.

Year	Supply	Predicted	residuals	% Deviation
1992	42.800.277	46.128.820	- 3.328.543	-7,22%
1993	45.000.492	47.172.314	- 2.171.821	-4,60%
1994	47.200.424	48.215.807	- 1.015.383	-2,11%
1995	48.000.374	49.259.301	- 1.258.927	-2,56%
1996	48.000.374	50.302.795	- 2.302.421	-4,58%
1997	49.200.383	51.346.289	- 2.145.905	-4,18%
1998	54.800.427	52.389.782	2.410.645	4,60%
1999	55.600.433	53.433.276	2.167.157	4,06%
2000	56.400.439	54.476.770	1.923.670	3,53%
2001	63.100.492	55.520.264	7.580.228	13,65%
2002	57.700.450	56.563.757	1.136.692	2,01%
2003	57.481.448	57.607.251	- 1.258.032	-2,18%
2004	59.860.466	58.650.745	1.209.721	2,06%
2005	59.690.465	59.694.239	- 3.773.688	-6,32%
2006	62.740.489	60.737.733	2.002.756	3,30%
2007	65.189.508	61.781.226	3.408.282	5,52%
2008	67.600.527	62.824.720	4.775.807	7,60%
2009	61.408.478	63.868.214	- 2.459.735	-3,85%
2010	60.111.469	64.911.708	- 4.800.239	-7,40%
2011	63.040.491	65.955.201	- 2.914.710	-4,42%
2012	62.911.000	66.998.695	- 4.087.695	-6,10%

Numer of classes (k) and sample size (n) is the same for both demand and supply, as long as Uzbekistan started extracting natural gas resources from year 1992. The main indicators of the supply side of natural gas market in terms of longer term forecast, can be constructed as follows:

By main indicators, we strictly mean the information provided in the table, however there are also other factors which are also the components of longer term analysis, we refer to them in table-8 and further.

Table 8: Main Indicators of Longer Term Analysis.

№	Indicator	Results
1	n	21
2	min	-7,40%
3	max	13,65%
4	range	21,05%
5	k	5
6	class size	4,21%

According to the results of indicators, it can be realized that this prediction is comparatively much more efficient due to the class size of supply trend which is relatively flat, 4,21% and lower ranges 21.05% compared to demand estimations.

Table – 9 presents the results of longer term forecast. Note that probability (or probability of occurance) is derived by deviding "frequencyof" to total number of observations, which is 21 here and it represents the associated probability distribution. By multiplying midpoints of classes to respective probabilities, we now have different expectations regarding future outcome.

Table 9: Frequency Table of Longer Term Natural Gas Supply.

№	Min	Max	Mid point	Frequency	Probability	Expected
1	-7,40%	-3,19%	-5,29%	4	19,05%	-1,01%
2	-3,19%	1,02%	-1,08%	8	38,10%	-0,41%
3	1,02%	5,23%	3,13%	6	28,57%	0,89%
4	5,23%	9,44%	7,34%	2	9,52%	0,70%
5	9,44%	13,65%	11,55%	1	4,76%	0,55%
			Total	21	100,00%	0,72%

According to the results, the expectations for supply in longer term are quite low. At the lowest estimate (solely based on historical data), production volumes are expected to fall by 1% per annum, while high estimate says that it will grow by 0.9% instead. According to best estimate however, production volumes are expected to rise at 0,72% annually in longer term.

Figure – 8 below presents the forecasted natural gas supply in energy market of Uzbekistan under three different scenarious:
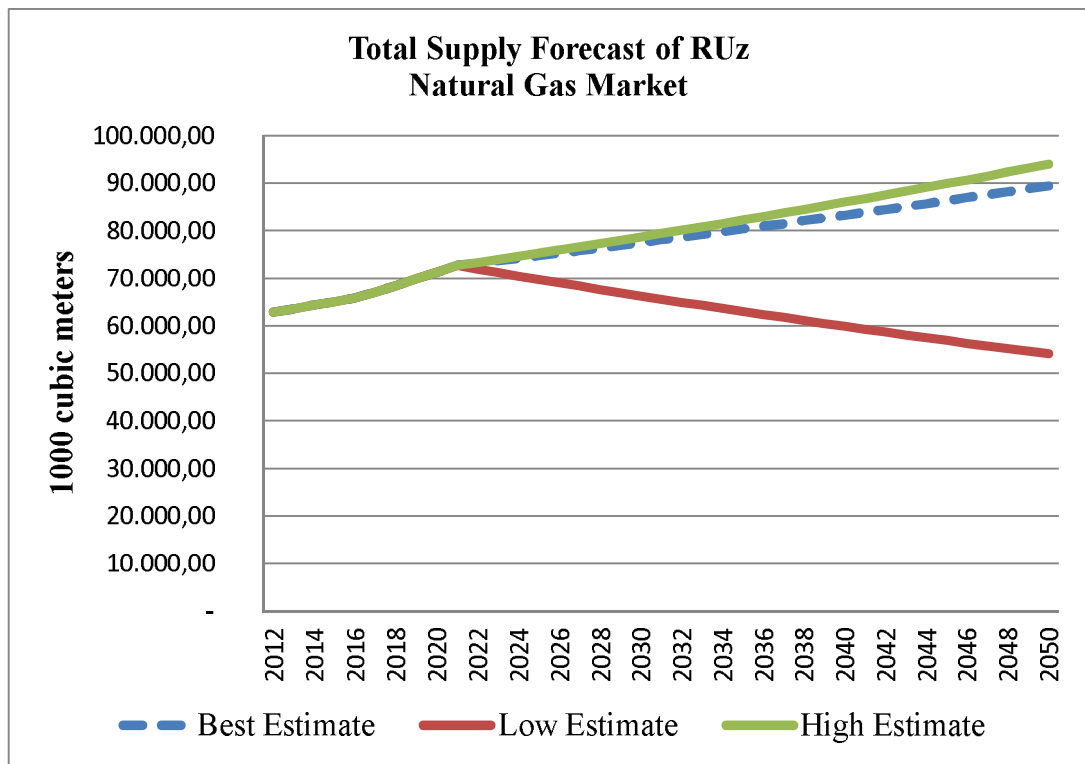

Figure 8: Forecasted Natural Gas Supply in RUz.

There is no change is expected till 2021 due to the assumptions imposed in short and medium term forecast. However, in longer term again solely based on historical data, production volumes are expected to slowdawn, but they stil increase in the cases of

best and high estimates. In the case of low estimate however, supply is expected to decrease instead.

If the actual production of natural gas will fall as in low estimated scenario, then domestic market will suffer from shortages, higher import requirements will increase the cost to the economy. Consequently, it is very much important to provide high productions by modernizing the existing technology and increasing the capacity of production.

5.2.2 Forecasted Results of Natural Gas Exports

There are currently four groups in total (as of 2013) that are benefiting from uzbek gas: Domestic consumers, Russia, Kyrgyzstan and newly entered group China.

Tajikistan however, is excluded from this list as the supply of uzbek gas to Tajikistan has been stopped since 31st of December, 2012 and no new cooperation plans in terms of contracts and agreements in gas field has been highlighted yet. It is a huge uncertainty; therefore we simply preferred not to include this group in our projections.

The case with Kyrgyzstan however is also challenging, agreements are being highlighted annually, both quantities and prices are flactuating significantly leading our analysis to be uncertain. But we cannot simply make similar assumption as to Tajikistan, because first of all there are still quantities supplied to Kyrgiz side per annum, it is assumed to be 145 million cubic meters in 2013 and secondly, Uzbekistan currently is Kyrgyzstan's only source of imported gas. It is not likely that

Uzbekistan stops gas supply to Kyrgiz side. Therefore, our assumption regarding quantities supplied remains constant over time (column B, appendix-1, scenario-1).

Domestic market remains the main group of demanders; it counts for over 70% of total production as of 2013. However, it is subject to restrictions due to huge potential export obligations. Uzbekneftegaz[9] signed new contract with Gazprom (Russia) for the years 2013 – 2015, the amount was assumed at 7.5 bmc. Also, in 2010, Uzbekistan signed an agreement with China to export 25 billion cubic metres in medium term. Currently, "plans are to supply 7.5 bcm of gas to Russia (column C, appendix-1, scenario-1) and 10 bcm to China this year", according to Neftegaz.ru (2013), an industry publication. Third pipe-line with the capacity of 25 bmc to China is currently being constructed. By the end of 2015, the construction of new pipeline is expected to complete. According to the contract of both sides, from year 2016 Uzbekistan stabilizes gas exports at 25 bmc level. It is maximum capacity of the 3rd line, so there is no expected growth of supply (column D, appendix-1, scenario-1).

As it was mentioned above, the export capacity of the country regarding natural gas is expected to grow due to export obligations and higher volumes of production. However, the actual export capacity with non-restrained demand case might be questioned.

Figure – 9 depicts three scenarios of actual export capacity in the case of non-restrained demand. According to the obtained results of all cases, the actual export

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[9] NHC "Uzbekneftegas" is a business association of voluntary members including government, quasi-government groups, leasehold, collective and joint venture companies, enterprises and organizations, as well as legal entities of other states which have a stake in the development of the oil and gas sector of RUz.

capacity is expected to fall if domestic demand for natural gas is non-restrained. In best case, the export capacity will be almost zero by year 2050, however, restrained demand will shift the trend of export capacity up. Note that the "dushed" line in figure does not represent the export capcity, it is the demand curve which is restrained. It shows that even if demand is restrained, it grows over time and heats 80 bmc by 2048, but within two years it will sharply go down and make zero due to exhausted reserves.

The comparative analysis of export capacity shows that if domestic demand is restrained due to export obligations, additional energy import requirements starts from the year 2048. However, if the demand is non-restrained then in worst case (where domestic demand for natural gas growths at high levels) importation of energy resources will be needed from the year 2040. According to best estimate, it shoud start later, even after year 2050.
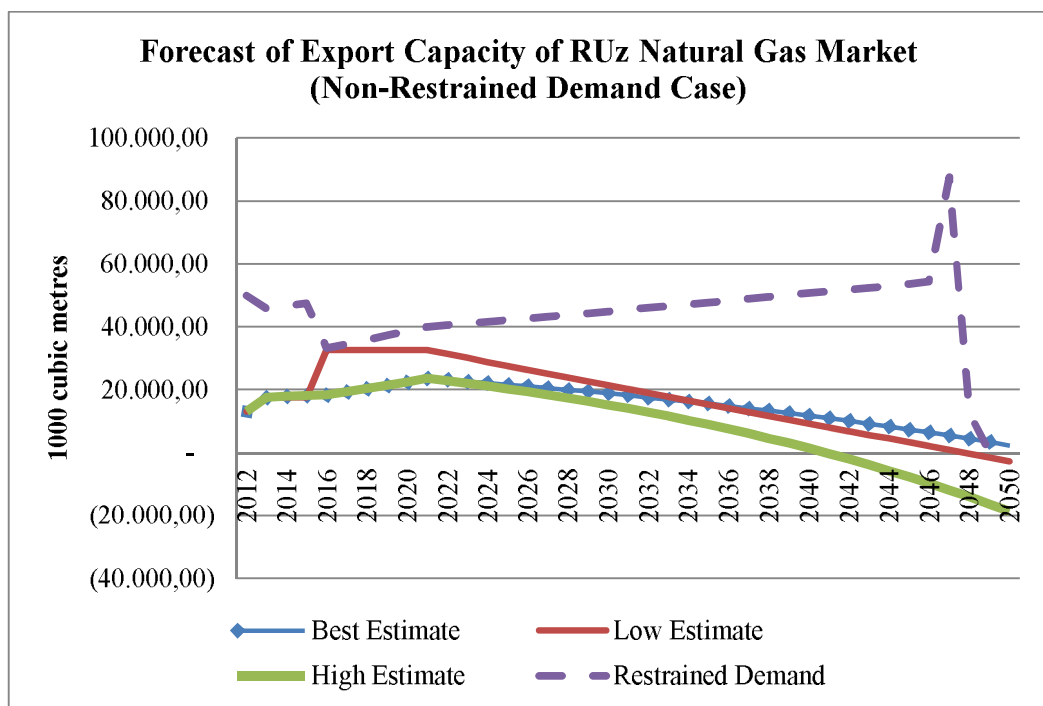
Figure 9: Forecast of Export Capacity of RUz Natural Gas Market
(Non-Restrained Demand Case)

Figure – 10 below shows the trend of prospective export capacity of Uzbekistan's natural gas under two different tipes of demand assumpions. The dashed line is the trend of export capacity if the demand is restrained due to the export obligations.

Restrained demand provides RUz keep upper bound on exports. Note that this case of export trend is expected if both domestic demand and supply volumes are expected at their best levels. In this case, Uzbekistan will be able to export natural gas untill 2035 making 686.2 billion cubic meters in total and the net present value of natural gas exports will be 4,504,713.86 US dollars under base case scenarios. For the results of alternative cases, see section 4.3. of chapter – 5.

If true volumes of domestic demand will be at best or high expected volumes, then domestic consumers will be restrained from year 2016 due to export obligations. However, if demand for natural gas will grow slowly, then there will not be a need to reduce domestic consumption till 2022.
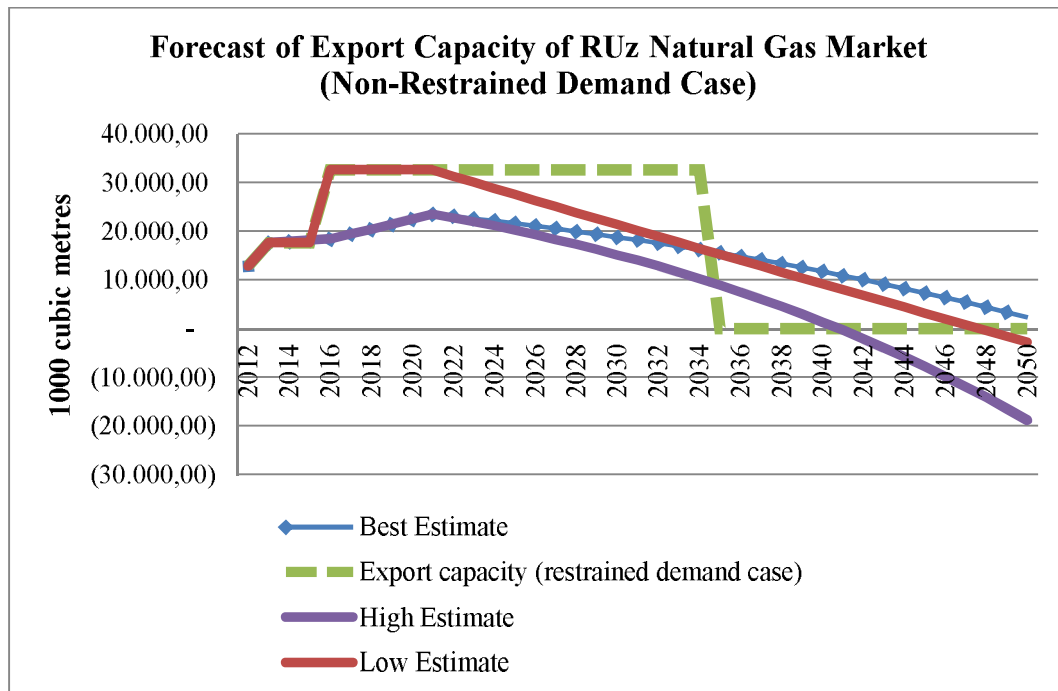
Figure 10: Forecast of Export Capacity of RUz Natural Gas Market
(Restrained v.s. Non-Restrained Demand Case)

5.3 Adequacy of Reserves

The adequacy of reserves is determined by the total quantity of available reserves and the rate of demand growth over time. This aspect has been analyzed in the context of three uncertainty categories, or scenarios:

i)   Low Estimate: 90% of Proven Reserves (Scenario 1);

ii)   Best Estimate: 90% of Proven Reserves + 50% of Possible Reserves (Scenario 2);

iii) High Estimate: 90% of Proven Reserves + 50% of Possible Reserves + 10% of Possible Reserves (Scenario 3).

i)   Low Estimate: Computation of Recoverable Reserves – Scenario 1.

Table – 10 below indicates the total recoverable volume of natural gas reserves of RUz under low estimates of total resources.

Table – 10. Low Estimated Recoverable Natural Gas Reserves (bmc).

Description	Estimated Reserves (bmc)	Probability	Recoverable Reserves (bmc)
Proven Reserves	1841	90%	1656,9
Probable Natural Gas Resources	2100	0%	0,0
Possible Natural Gas Resources	5900	0%	0,0
Total Reserves	**9841**		**1656,9**

From the available total recoverable reserves of **1656,9** billion cubic metres, Uzbekistan will exhaust natural gas reserves by 2035 if it meets both export obligations and restrained domestic demand. Note that, in this case both demand and supply of natural gas are based on best estimation. However, conclusions change if the expectations regarding the growth rates of demand and supply.

ii)   Best Estimate: Computation of Recoverable Reserves – Scenario 2

Table – 11 below shows the computation of recoverable reserves under best estimation method, which is sometimes refered as "2P" method.

Table 11: Best Estimated Recoverable Natural Gas Reserves (Bmc).

Description	Estimated Reserves (bmc)	Probability	Recoverable Reserves (bmc)
Proven Reserves	1841	90%	1656,9
Probable Natural Gas Resources	2100	50%	1050,0
Possible Natural Gas Resources	5900	0%	0,0
Total Reserves	**9841**		**1706,9**

The volume of recoverable reserves in such a case is 90 percent probability times total volume of proven reserves plus a half of estimated probable volume of natural gas resources. So under best estimate method, the volume of recoverable reserves count for about 1,7 trillion cubic meters out of 9,8 trillion available. No possible reserves are considered. In this case, the total recoverable natural gas reserves of Uzbekistan will exhaust at least in 2047 or at most 2056 (see table – 13 on page 57) depending on demand and supply expectations.

iii)   High Estimate: Computation of Recoverable Reserves – Scenario 3.

Table – 12 below indicates the calculation of highly estimated recoverable reserves, also known as "3P" reserves. This is a very optimistic approach regarding recoverability of reserves, as the 10% of possible reserves are encountered as recoverable and added up to the amount of"2P" reserves.

Table 12: High Estimated Recoverable Natural Gas Reserves (bmc).

Description	Estimated Reserves (bmc)	Probability	Recoverable Reserves (bmc)
Proven Reserves	1841	90%	1656,9
Probable Natural Gas Resources	2100	50%	1050,0
Possible Natural Gas Resources	5900	10%	590,0
Total Reserves	**9841**		**3296,9**

However, when the available natural gas reserves of Uzbekistan will exhaust depends not only on recoverability estimates, but also on prospective consumption and production volumes.

The table – 13 below shows the adequacy of natural gas reserves with respect to time, based on different expectations of future domestic demand and supply.

Table 13: Adequacy of Recoverable Natural Gas Reserves with Respect to Time.

Scenario	Demand Estimate	Supply Estimate	Recoverable Reserves	Year of Fully Exhausted Reserves
1	Best	Best	Low	2035
1a	High	Low	Low	2037
1b	Low	High	Low	2035
2	Best	Best	Best	2048
2a	High	Low	Best	2056
2b	Low	High	Best	2047
3	Best	Best	High	2054
3a	High	Low	High	2065
3b	Low	High	High	2053

According to the results of 9 modeled scenarios, which differ from each other by future expectations, the recoverable reserves of RUz will be enough to meet both domestic and foreign requirements at least till year 2035. The models have been projections till year 2065, so it is possible that there still might be some amount of recoverable reserves left for future extraction. But that amount is not much, 121.2 billion cubic meters which is enough to serve the economy 2 more years only. Consequently, under the given all assumptions and expectation approaches, the available natural gas reserves of Uzbekistan will exhaust by maximum 2068. Now we can carry out a benefit-cost analysis for these reserves.

5.4 Benefit Cost Analysis

This analysis is about present benefits and future costs. Benefits are accrued from exportation of natural gas resources, while costs come from additional import requirements of energy resources in future, once available gas reserves fully exhaust.

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The main assumption of this analysis is that domestic demand will be restrained due to export obligations of the country. Also, exportation will last untill available recovarable reserves fully exhaust.

The figure – 11 shows the comparative economics of natural gas market of uzbekistan in terms of cumulative values of projected model parameters under given above assumptions. The graphs were obtained under Scenario-1 (Best-Best-Low) assumptions:

a) Pessimistic point of view regarding natural gas reserves was imposed, i.e. only 90% of proven reserves were considered as available reserves;

b) However, prospective demand and supply volumes for this example were based on best estimates;

c) General assumptions were considered as well.
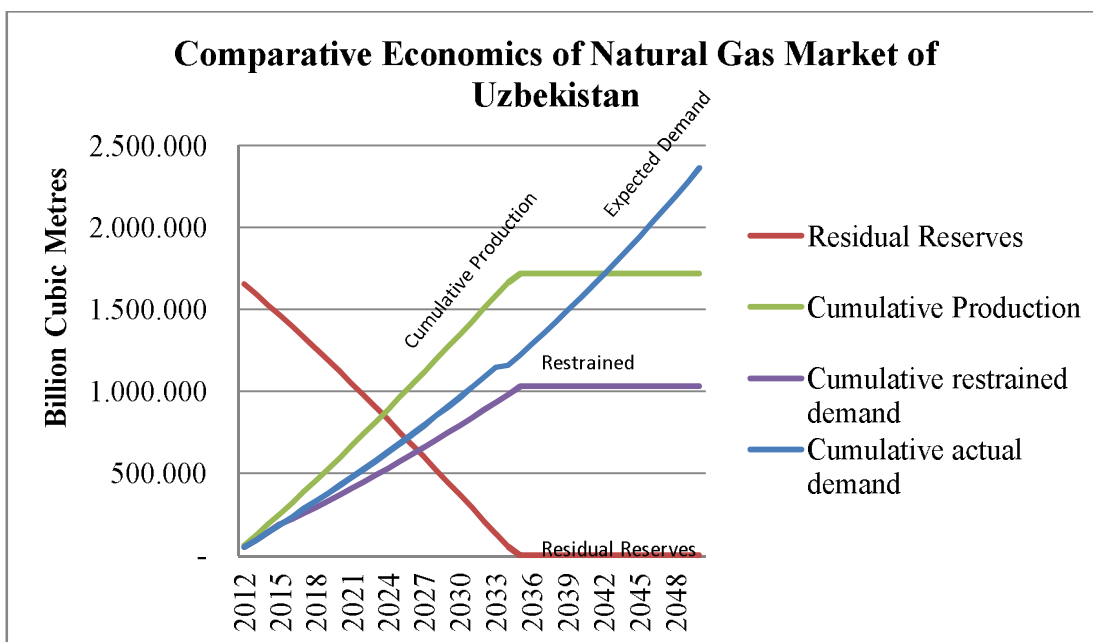
Figure 11: Comparative Economics of Natural Gas Market of Uzbekistan.

This figure is just one example of different possible scenarios, the results of all other cases were followed in table – 13 above and appendices.

The figure ultemately shows the relationship of residual (i.e. remaining) reserves and cumulative consumption as well as production levels. Actually expected values of demand are much higher than supplied volumes of natural gas to domestic consumers. Expected demand restrained downwards. Supply however is determined by the existing capacity of production volumes and future projection was reconciled with the historical trend. The export capacity is growing gradually, due to restrained nature of domestic demand. The cumulative export volume is just the difference between cumulative production and cumulatie restrainde domestic demand volumes.

From the obtained figure, it also can be realized that the future costs are significantly increasing over time as the "corridor" between actually expected and restrained cumulative demand curves is becoming wider.

So, is The Republic of Uzbekistan better off from the exportation of available natural gas resources in question, net present value (NPV) criterion have been calculated. NPV of natural gas exports is just the difference of total royalty payments and costs caused by additional energy imports in present value terms.

5.4.1 Royalty Paments

Royalty payments represent the monetary benefit that Uzbekistan will realize from the exports. The figure however, is quite hypothetical as the real prices, royalty rates as well as operation costs are held constant over time.

The table – 14 shows the results of total royalty payments in present value terms under 9 imposed different scenarios.

Table 14: Present Value of Benefits.

Scenario	Demand Estimate	Supply Estimate	Recoverable Reserves	Present Value of Royalty (USD)
1	Best	Best	Low	9.671.588,26
1a	High	Low	Low	9.515.711,34
1b	Low	High	Low	9.685.515,73
2	Best	Best	Best	10.597.433,88
2a	High	Low	Best	10.150.571,91
2b	Low	High	Best	10.638.687,60
3	Best	Best	High	10.804.501,41
3a	High	Low	High	10.229.526,78
3b	Low	High	High	10.858.558,67

The royalty payments are not independent of available natural gas reserves due to the assumption that natural gas exports of Uzbekistan will last untill total recoverable reserves exhaust. However, benefits are not changing much with respect to different scenarios of expectations. It was an unexpected result (at least for the author). Even in quite pessimistic case (scenario-1a) where low production, low available natural gas reserves and high consumption volumes are expected, total value of royalty payments are strongly above 9,5 million US dollars in real terms as of 2013. In general, royalty payments are reluctant with respect to model parameters, as they are within the range of 9,5-11 million USD under 9 imposed scenarios. However they are quite sensitive to such variables as real well-head price of natural gas, export prices and real discount rate. We refer to them in section 5.5.

5.4.2 Future Cost of Imports

Once the available reserves are exhausted, Uzbekistan will have to if possible produce, if not import additional amounts of close substitute. As it was mentioned earlier, in this study coal was considered as a close substitute for natural gas in electricity generaton projects which are main demanders of fuel resources in RUz.

The table - 15 below indicates the total costs caused by fuel imports in present terms. As opposed to royalty payments, the cost of imports is very much sensitive to constructed model parameters. It is obvious, because the quantities of import first of all depends on actual demand in domestic market and the domestic consumption is restrained because of huge export obligations. Domestic consumers have to substitute.

Table 15: Present Value of Costs.

Scenario	Demand Estimate	Supply Estimate	Recoverable Reserves	Present Value of Coal Imports (PV of Costs) (USD, as of 2013)
1	Best	Best	Low	5.166.873,39
1a	High	Low	Low	6.474.644,33
1b	Low	High	Low	3.701.765,59
2	Best	Best	Best	4.912.177,25
2a	High	Low	Best	7.523.422,61
2b	Low	High	Best	1.916.664,81
3	Best	Best	High	4.691.978,00
3a	High	Low	High	7.816.751,26*
3b	Low	High	High	1.584.960,55

The difference on timing of energy imports will impact on the present value of future imports. Under best assumptions of model parameters (scenario-2), the total cost of imports is almost 5 million US dollars which is twice less than benefits under the

same scenario. It is due to the fact that costs are shifted to the future. The higher the shortage in domestic market the higher is the expected cost. Worst case is presented in scenario-3a, where actual demands are expected to be high under low production volumes, even while recoverable reserves are estimated at "3P" level. The opposite case is shown in section-3b, due to the lower expectations of domestic consumption and high volumes of production, total cost of future imports make about1,58 million US dollars. It is however, a quite optimistic approach to the future.

5.4.3 Net Present Value of Natural Gas Exports

This section analyses the net impact of the costs and the benefits on the economy of The Republic of Uzbekistan.

In any economic activity, there are gainers and losers. If domestic consumers have losses in future, it does not mean that Uzbekistan should stop exporting. From economic point of view, there is huge potential net benefit of natural gas exports due to two facts: First is because of present benefits and shifted to the future costs, we can call it "time value" and second is lower production cost and high international prices of natural gas.

The table – 16 below summarizes the net present value of natural gas exports of Uzbekistan for the nine scenarios. Note that second column refers to the estimate methods of demand, supply and recoverable reserves respectively, e.g. Best-Best-Low of scenario-1 means that both demand and supply were based on best estimate, while recoverable reserves on low estimate.

Table 16: Net Present Value of Natural Gas Exports

Scenario	Estimate	Present Value of Royalty	Present Value of Imports	Net Present Value
1	Best-Best-Low	9.671.588,26	5.166.873,39	4.504.714,86
1a	High-Low-Low	9.515.711,34	6.474.644,33	3.041.067,01
1b	Low-High-Low	9.685.515,73	3.701.765,59	5.983.750,14
2	Best-Best-Best	10.597.433,88	4.912.177,25	5.685.256,63
2a	High-Low-Best	10.150.571,91	7.523.422,61	2.627.149,30
2b	Low-High-Best	10.638.687,60	1.916.664,81	8.722.022,79
3	Best-Best-High	10.804.501,41	4.691.978,00	6.112.523,40
3a	High-Low-High	10.229.526,78	7.816.751,26	2.412.775,52
3b	Low-High-High	10.858.558,67	1.584.960,55	9.273.598,12

Net Present Value (NPV) is just the difference between total royalty payments and coal import requirements in present value terms. If NPV were less than zero, then we would conclude that Uzbekistan should not be involved in exportation of natural gas, however the obtained figures say the opposite. The minimum NPV of nine imposed scenarios is greater than real 2.4 million US dollars, in present value terms, as of year 2013. Due to different approaches to the projection of model parameters, NPV is fluctuating a lot but still is not turning negative even in quite pessimistic cases. As benefits are more reluctant to these approaches (see table – 14 or 16), NPV is mainly fluctuating because of highly sensitive costs to estimated demand, supply and reserve volumes.

However, we need to know all the variables (at least the ones included in our model) that affect NPV criterion as long as it is a most important criterion that represents the result of benefit – cost analysis of natural gas exports in our projections. Sensitivity analysis is a helpful tool for such a purpose.

5.5 Sensitivity Analysis

The interaction of project variables results in different set of outcomes for the project (Farai Kanonda, 2008). Consequently, one needs to make analysis based on deterministic approach by applying single values first and then carry out a sensitivity analysis in order to define impact of single variables in projected outcomes. One stregth of this analysis is that it shows the impact of one single variable in projected outcome, holding everything else constant. There is also weakness' of this analysis, it just lets us know whether a variable is sensitive or not, however it does not provide weights of the impact, probabilities and ranges of the variable. For such a purpose, one may need a risk analysis or Monte Carlo simmulation. However, in this study we are not very much concerned with the monetary values of projected outcomes due to the uncertainties regarding prices and market conditions. We are much more interested in quantities of natural gas resources, and the resources allocation under different scenarios. However, the impact of price changes is also important as we are dealing with benefits and costs of projections. Consequently, sensitivity analysis is required.

5.5.1 Sensitivity Analysis of Real Discount Rate

The table – 17 below denotes one example of nine existing scenarios. This table was obtained based on the most pessimistic scenario – 3a, where future expectations of demand are high with the low estimates of production and recoverable reserves volumes. The table shows how the projected outcomes, namely benefits, costs, capital contribution values and net benefits in present value terms respectively, will respond to the changes of real discount rate which is weighted average cost of capital

(WACC) here. In base case scenario, where WACC was assumed to be 11%, benefits exceeded costs, if we start increasing the real discount rate all figures will start falling except NPV criterion of natural gas exports. That is due to the fact that the benefits which are represented in terms of royalty payments are decreasing less then costs caused by energy imports. That is sometimes called "time value", as long as costs are shifted to the future, there are acrued additional benefits to the economy due to imposed higher rates of WACC.

Table 17: Sensitivity Analysis of Real Discount Rate.

Real Discount rate (WACC)	Present Value of Royalty Payments (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
4%	27.837.183,80	29.815.275,28	185.027.134,29	- 1.978.091,48
5%	22.436.750,11	23.811.005,46	145.910.885,65	- 1.374.255,35
6%	18.665.573,43	19.236.533,94	118.805.045,80	- 570.960,50
7%	15.951.923,45	15.719.500,75	99.480.765,35	232.422,70
8%	13.939.626,73	12.990.521,66	85.301.677,08	949.105,07
9%	12.403.395,72	10.853.387,92	74.599.962,95	1.550.007,79
10%	11.198.331,37	9.164.212,32	66.303.538,99	2.034.119,05
11%	10.229.526,78	7.816.751,26	59.711.222,87	2.412.775,52
12%	9.433.588,43	6.732.013,80	54.355.808,28	2.701.574,64
13%	8.767.282,86	5.850.862,85	49.919.798,04	2.916.420,01
14%	8.200.480,72	5.128.716,23	46.182.959,87	3.071.764,49
15%	7.711.717,38	4.531.729,44	42.989.292,48	3.179.987,94

*Note that dashes in the table represent the negative sigh of the figure, i.e. the result is negative.

However, Uzbekistan would start having losses, if the WACC falls below 7%. As we can see, under the given assumptions and constrains, from the exportation of natural gas the economy will have more than half million USD of net losses in real terms, as of year 2013. Those losses will be even more, if the real discount rate drops further, about 1.34 million USD if 5% or almost 2 mln. USD if 4% respectively. In reality

however, it is not likely to happen, as long as projection is drawn to longer term. The longer term considered, the more risk will be associated, consequently more of real discount rate will likely be imposed.

5.5.2 Sensitivity Analysis of Real Well-head Price of Natural Gas.

Table – 18 below indicates the results of sensitivity analysis of projected outcomes with respect to real well-head price of natural gas. This table is constructed based on scenario-2, where prospective domestic demand, supply and available reserves are estimated on best expectation volumes. For the results of other scenarios, refer Appendices 1-9. At a base case scenario, where well-head price was assumed at 50 US dollars level per 1000 m^3 of natural gas, the economy would have about 5.7 million USD net benefits, and the flow to capital contribution would be almost 10 times more than that value in present terms, as of year 2013.

Table 18: Sensitivity Analysis of Real Well-head Price of Natural Gas.

Real Well-head Price of Gas (USD)	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
35	7.418.203,72	3.438.524,08	61.805.891,66	3.979.679,64
40	8.477.947,10	3.929.741,80	60.388.285,41	4.548.205,30
45	9.537.690,49	4.420.959,53	58.970.679,17	5.116.730,97
50	10.597.433,88	4.912.177,25	57.553.072,93	5.685.256,63
55	11.657.177,27	5.403.394,98	56.135.466,68	6.253.782,29
60	12.716.920,66	5.894.612,70	54.717.860,44	6.822.307,95
65	13.776.664,04	6.385.830,43	53.300.254,19	7.390.833,62
70	14.836.407,43	6.877.048,15	51.882.647,95	7.959.359,28
75	15.896.150,82	7.368.265,88	50.465.041,71	8.527.884,94

Again, all the projected outcomes are sensitive to real well-head price of natural gas, however not that much as the real discount rate. It is never turning projected outcomes to negative, in any case and any scenario, benefits exceed costs in present terms. The higher the real well-head price is, the more the economy will benefit, however project owners will have less inflows for the capital recovery.

5.5.3 Sensitivity Analysis of Real Export Prices.

Table – 19 below shows the responsiveness of projected outcomes with respect to percentage change of real price exports. The construction of the table was based on scenario-1a, where both demand and supply were expected at best volumes, while the recoverable reserves are considered at a 90% of currently proven amount. It is just one example of imposed nine scenario cases (see appendices 1-9).

Table 19: Sensitivity Analysis of Real Export Prices

Percentage Change of Real Export Prices	Present Value of Royalty Payments (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
-10%	9.515.711,34	6.474.644,33	42.623.664,50	3.041.067,01
-5%	9.515.711,34	6.474.644,33	48.064.305,39	3.041.067,01
-2%	9.515.711,34	6.474.644,33	51.446.808,00	3.041.067,01
-1%	9.515.711,34	6.474.644,33	52.593.995,22	3.041.067,01
0%	9.515.711,34	6.474.644,33	53.751.025,60	3.041.067,01
1%	9.515.711,34	6.474.644,33	54.917.899,17	3.041.067,01
2%	9.515.711,34	6.474.644,33	56.094.615,90	3.041.067,01
5%	9.515.711,34	6.474.644,33	59.683.825,13	3.041.067,01
10%	9.515.711,34	6.474.644,33	65.862.703,98	3.041.067,01

The present values of benefits and costs, consequently net present value of natural gas exports are independent of real export price changes, therefore the results are not changing with resect to percentage changes of real export prices. However, it is quite

importan variable from poject owners point of view, we mean "Uztransgaz" JS Company, as the capital contribution volumes directly depends on export prices. The higher prices in real terms, the more capital contribution is expected and it is true for any imposed cases and scenarios of future expectations.

Chapter 6

CONCLUSION

A major concern in the debate on the future of energy markets is resource scarcity. Uzbekistan has abundant natural gas reserves. However, how to use those reserves is a big challenge. Some economists argue that Uzbekistan should first of all meet domestic requirements and then export the remaining amounts, while others believe that RUz should export natural gas now and develop the natural gas field, expand it, use new innovative technology and try to increase production volumes in near future. However, in any case, there is reserves constraint which makes one to think of better policy so that higher return would be expected. This paper attempted to analyze the situation from economics perspective by comparing the benefits obtained from natural gas exports in near future to the costs caused by energy import requirements in longer term, once the available natural gas reserves exhaust. Consequently, a cost-benefit analysis of Uzbekistan's natural gas exports was modeled, taking the given available reserves constraint into account. For that purpose, it was required to have a proper analysis of future demand and supply volumes of natural gas in the region, the results of analysis are as follows:

1. Short term and medium term forecast. Several studies have been done with respect to approximations of prospective volumes of demand and supply for natural gas of

Uzbekistan. However, the trade environment of the market has drammatically changed for last 5-6 years, due to the enterance of China as a major demander of natural gas in Uzbekistan and Central Asia region as a whole. Consequently, most of previously obtained results are not very much reliable now. Therefore, there was a need of proper analysis of prospective demand and supply volumes. The forecasted volumes of short term and medium term were reconciled with the forecasted results provided by BMI. Consequently, it was assumed that demand and supply will grow at 1% and 1.15% in short term (in 2013-2016), also 0.7% and 2% in medium term (2016-2021) respectively. However, these values were accepted as true values in projected model.

2. Longer term forecast. Longer term growth rate was based on different scenarios as it captures longer period, from 2021 to 2065. Under best assumptions, demand for natural gas should rise by 2% per annum. According to optimistic results, domestic demand should fall by about 1.3% per annum in longer term. Optimistic, because as lower the demand is, so less will be the amount of shortage under fixed levels of export obligations, consequently the lover costs will be expected to the economy. However, one can be pessimist, in such a case demand would grow by about 3% per annum.

Growth rate of supply in longer term is expected to be lower compared to demand. At the lowest estimate (solely based on historical data), production volumes are expected to fall by 1% per annum, while high estimate says that it will grow by 0.9% instead. According to best estimate however, production volumes are expected to rise at 0,72% annually in longer term.

4. Export capacity. If prospective demand is restrained, then maximum exported volume of natural gas would amount for about 1,698.2 billion cubic metres in total up to 2065, also remaining some 120 million cubic metres reserves would have left. This result is obtained under 3a scenario, where the available reserves are assumed to be highly recoverable ("3P" approach). However, it is interesting that there is still residual volume of natural gas reserves is expected, even while demand was expected to be high with low production volumes. The lowest volume of natural gas exports, 686.2 million cubic metres is expected under scenarios 1 and 1b, where only 90% of proven reserves was considered to be recoverable.

5. Adequacy of reserves with respect to time. According to the results of 9 modeled scenarios, which differ from each other by future expectations, the recoverable reserves of RUz will be enough to meet both domestic and foreign requirements at least till year 2035. The models have been projections till year 2065, so it is possible that there still might be some amount of recoverable reserves left for future extraction. But that amount is not much, 121.2 billion cubic meters which is enough to serve the economy 2 more years only. Consequently, under the given all assumptions and expectation approaches, the available natural gas reserves of Uzbekistan will exhaust by maximum 2068.

6. Benefits. Total benefits from natural gas exports are not changing much with respect to different scenarios of expectations. It was an unexpected result (at least for the author). Even in quite pessimistic case (scenario-1a) where low production, low available natural gas reserves and high consumption volumes are expected, total value of royalty payments are strongly above 9,5 million US dollars in real terms as

of 2013. In general, royalty payments are reluctant with respect to model parameters, as they are within the range of 9,5-11 million USD under 9 imposed scenarios. However they are quite sensitive such variables as real well-head price of natural gas, export prices and real discount rate.

7. Costs. Once the available reserves are exhausted, Uzbekistan will have to if possible produce, if not import additional amounts of close substitute, which is coal in this case. Future imports of coal is the cost for the economy. As opposed to royalty payments, the cost of imports is very much sensitive to constructed model parameters. It is obvious, because the quantities of import first of all depends on actual demand in domestic market and the domestic consumption is restrained because of huge export obligations. Domestic consumers have to substitute more. The highes cost is expected in the case of scenario 3a (highly estimated reserves case), while the lowest is expected in 2b, where low demand, high production was expected under best estimation of available recoverable reserves.

8. Net economic benefits. Net economic benefits are represented by net present values (NPV) of natural gas exports and is just the difference of benefits and costs in present value terms, as of 2013. The minimum NPV of nine imposed scenarios is greater than real 2.4 million US dollars, in present value terms, as of year 2013. Due to different approaches to the projection of model parameters, NPV is fluctuating a lot but still is not turning negative even in quite pessimistic cases. As benefits are more reluctant to these approaches, NPV is mainly fluctuating because of highly sensitive costs to estimated demand, supply and reserve volumes.

9. Impact of real discount rate. NPV is highly sensitive with respect to real discount rate, which is weighted verage cost of capital (WACC) in this case. There is a chance for Uzbekistan to have losses from natural gas exports, if the WACC falls below 7%. Under the given assumptions and constrains, from the exportation of natural gas the economy will have more than half million USD of net losses in real terms, as of year 2013. Those losses will be even more, if the real discount rate drops further, about 1.34 million USD if 5% or almost 2 mln. USD if 4% respectively. In reality however, it is not likely to happen, as long as projection is drawn to longer term. The longer term considered, the more risk will be associated, consequently more of real discount rate will likely be imposed.

10. Impact of well-head price of natural gas. The present values of benefits and costs, consequently net present value of natural gas exports are independent of real export price changes, therefore the results are not changing with resect to percentage changes of real export prices. However, it is quite importan variable from poject owners point of view, we mean "Uztransgaz" JS Company, as the capital contribution volumes directly depends on export prices. The higher prices in real terms, the more capital contribution is expected and it is true for any imposed cases and scenarios of future expectations.

Generally speaking, the comparative economics of natural gas market of Uzbekistan shows that Uzbekistan's benefits from the exportation of natural gas resources will exceed the respective costs caused by importation of coal in future. Allowing natural gas exports has the potential to help the uzbek economy by increasing economic output of RUz and, by attracting foreign investments indeed.

REFERENCES

A Korzhubayev, I Filimonova, A Meshcherin, O Lukin 'The oil and gas complex of Uzbekistan: trade association review' / Oil and gas of Uzbekistan: special issue of 'Oil and gas vertical', Moscow no 9, 2007 pp. 58.

AIAC (Avesta Information and Analysis Centre), "Oil and gas sector of Uzbekistan" – Sector Reviews, Tashkent, October 2006, 2007.

A. Korzhubayev, I. Filimonova, A. Meshcherin, "The oil and gas complex of Uzbekistan: trade association review" / Oil and gas of Uzbekistan: special issue of 'Oil and gas vertical', Moscow no 9, 2007 pp 58.

BMI, Uzbekistan Oil and Gas Report Q1, 2013. (Available at, http://www.marketresearch.com/Business-Monitor-International-v304/Uzbekistan-Oil-Gas-Q1-7288186/

BP, Statistical Review of World Energy, 2005. Available at, http://www.bp.com/liveassets/bp_internet/globalbp/globalbp_uk_english/publications/energy_reviews_2005/STAGING/local_assets/downloads/pdf/statistical_review_oil_reserves_2005.pdf

Chad Potter, TransAtlantic Petroleum Announces Operating Results, 2012 Proved Reserves, and Provides an Operational Update, 2013. Available at,

http://www.transatlanticpetroleum.com/media/3569/TAT_News_2013_3_13_General_Releases.pdf

EIA (Energy Information Administration), 2012 Available at, http://www.eia.gov/countries/country-data.cfm?fips=UZ

Farai Kanonda, Glenn P. Jenkins "Evaluation of the Economic Benefits to Peru from Liquefied Natural Gas Exports", Eastern Mediterranean University, 2008, pp. 20.

Gi Jung, Kyoung-Shik Kim, Kwang-Su Hwang, "Comparative economics of natural gas project in the Central Asian countries: Kazakhstan, Turkmenistan, and Uzbekistan", 2008, pp. 1, 6.

Hendrick S. Houthakker and Lester D. Taylor. (1966). Consumer Demand in the United States, 1929-1970. Cambridge: Harvard University Press.

Howard Rogers, LNG Trade Flows in the Atlantic Basin: Trends and Discontinuities (Oxford Institute for Energy Studies, March 2010); Akira Miyamoto and Chikako Ishiguro, A New Paradigm for Natural Gas Pricing in Asia (Oxford Institute for Energy Studies, 2009); Morten Frisch, 'Europe Spot Gas Prices: A GECF Challenge', Middle East Economic Survey, 2010.

J. Scott Armstrong, "Forecasting by Extrapolation: Conclusions from Twenty-five Years of Research", Postprint version. Published in Interfaces, Volume 14, Issue 6, 1984, pp. 52-66. Available at,

http://repository.upenn.edu/cgi/viewcontent.cgi?article=1083&context=marketing_pa
pers

Johnathan Mun, "Applied Risk Analysis: Moving Beyond Uncertainty and Risk in
Business", 2004, pp. 184.

Michael Fredholm, "The World of Central Asian Oil and Gas Power: Politics,
Market Forces, and Stealth Pipelines", Asian Cultures and Modernity Research
Report No. 16, 2008. Available at,
http://www.gpf-europe.com/upload/iblock/11e/fredholm.energy.euroasia.rr16.pdf

Michael Ratner, "Global Natural Gas: A growing resource", December 22, 2010.
Available at, www.fas.org/sgp/crs/misc/R41543.pdf

NGE (Natural Gas Europe), Uzbekistan's Strategy to Become a Gas Exporting
Country, 2013. Available at,
http://www.naturalgaseurope.com/uzbekistans-strategy-to-become-a-gas-exporting-
country

Reinhard Madlener, "Economic Analysis of Residential Energy Demand: A Survey",
The Journal of Energy Literature II, 2, 1996. pp. 23-24. Available at,
http://www.eonerc.rwth-aachen.de/global/show_document.asp?id=aaaaaaaaaabseav.

Sh Kh Mazhitov, "NKhK "Uzbekneftegaz" at its present stage of development", The energy market of Central Asia: trends and prospects, Proceedings of science and business conference, 6-7, 2005. Tashkent: Patent-Press, 2006, pp.45.

SPEE "Definitions of oil and gas resources and reserves", (Calgary Chapter), Second Edition, 2007, pp.13. Available at,
http://www.albertasecurities.com/securitieslaw/Regulatory%20Instruments/5/2232/C OGEHs.5DefinitionsofOilandGasResourcesandReserves.pdf

Uzbekneftegaz, Oil and gas of Uzbekistan: special edition, Neftegazovaya Vertikal journal (Russia) – Moscow, 2007, No 9;

Uzbekistan country profile, Available at,
www.ebrd.com/downloads/legal/irc/countries/uzbekistan.pdf

Vladimir Paramonov, The Future Supply of Gas from Central Asia to Russia: An Expert Assessment. Advanced Research and Assessment Group, UK Defence Academy, Central Asian Series 08/05, February, 2008.

V. Paramonov, A. Strokov "Russian Oil and Gas Projects and Investments in Central Asia" Advanced Research and Assessment Group ISBN 978-1-905962-51-8 2008, pp.10.

Vladimir Paramonov and Aleksey Strokov, Russia-Central Asia: Existing and Potential Oil and Gas Trade Advanced Research and Assessment Group, UK Defence Academy, Central Asian Series 08/03, February, 2008.

Available at, mercury.ethz.ch/serviceengine/Files/ISN/.../en/08_Feb_Russia.pdf

APPENDICES

APPENDIX 1
Scenario 1. Best-Best-Low*

TABLE OF PARAMETERS

Prices, as of 2012

Well Head Price of gas	50,00	USD / 1000 m3
Well Head Price of Natural Gas in Coal Equivalence	118,03	USD / Ton of coal (including transportation cost)
Percentage Change of Real Export Prices	0%	*Base case scenario

Royalty Rate

	30%	"Uztransgas" JS Company
WACC	11%	*estimated (not constant over time)

Kwh generated per unit of fuel used	1870	kWh per Ton of Coal
	125	kwh per 1000 cubic feet of natural gas

Conversio n Factor	0,4236	19328 Ton of Coal per 1000 cm of Natural Gas

Production Costs

Production Cost	35,00	($/1000m3)
Production cost in coal equivalence / ton	82,6	($/Ton of coal)
Worth of 1 Ton coal in terms of Well Head Price net of Production costs of Natural Gas	35.4	($/Ton of coal)

	Bmc	Probability	Recoverable Reserves (bmc)
Total Proven Reserves	1.841,00	90%	1.656,90
Probable Natural Gas Resources	2.100,00	50%	1.050,00
Possible Natural Gas Resources	5.900,00	10%	590,00

Conversions

1 bmc (billion cubic metres)	1.000.000.000 mc (cubic metres)
1000 m3 or thousand mc	1.000 cubic metres
1 cubic foot	0,0283168 cubic metres
1 Tcf (Trillion cubic feet)	28,3 bmc

UZBEKISTAN NATURAL GAS DEMAND/SUPPLY MODULE

	Data as of Year 2012				Data as of Year 2013			
	Russia	Tajikistan	Kyrgyzistan	China	Russia	Tajikistan	Kyrgyzistan	China
Export Price ($/1000m3)	253	253	300	290	253	253	300	253
Export Volume (bcm)	8,7	0,155	0,145		7,5		0,145	10
Total Rev≈USD	2.201.100.000	46.500.000	42.050.000	1.012.000.000	1.897.500.000		36.685.000	2.530.000.000
Contribution of Export Price to Capital Recovery (per 1000m3) As of **2012**	203,00	203,00	250,00	240,00	203,00	203,00	250,00	203,00
Total Value of Contribution USD	1.766.100	38.750	34.800	812.000	1.522.500		29.435	2.030.000

*Demand/Supply assumptions table	Russia	Tajikistan	Kyrgyzistan	China	Supply (Production)	Domestic Demand	Export Capacity
Total Volume (1000 m3 as of 2012)	8.700	155	145	4.000	62.911	49.911	13.000
Total Volume (1000 m3 as of 2013)	7.500	0,00	145	10.000	63.634	45.989	17.645
Short term annual growth rate (2012-2016)	0%	0%	0%	0%	1,15%	1,00%	1,72%
Medium term annual growth rate (2016-2021)	0%	0%	0%	25.000	2,0%	0,70%	7,76%
Longer term annual growth rate (up to 2050)	0%	0%	0%	0%	0,72%	2%	1,42%

*NOTE: Scenarios refer to the estimated volumes, i.e. Best-Best-Low means best estimated demand, best estimated supply, and low estimated recoverable natural gas reserves respectively.

Cost-Benefit Analysis of Natural Gas Exports

Year	Quantity of Gas Supplied to Tajikistan and Kyrgyzstan (1000 cubic meters)	Quantity of Gas Supplied to Russia (1000 cubic meters)	Quantity of Gas Supplied to China (1000 cubic meters)	Supply (Total Volume of Gas Production) (1000 cubic meters)	Quantity of Gas Supplied to Domestic Market (1000 cubic meters)	Value of Exports Net of Wellhead Price and transport cost (USD Real)	Royalty Payment (USD Real)	Domestic Demand Natural Gas (1000 cubic meters)	Domestic Demand plus Export Demand Natural Gas (1000 cubic meters)	Available "1P" Reserves (1000 cubic meters)	Amount Needed to Meet Domestic Volume of Gas Demand (1000 cubic meters)	Quantity of Required Gas Imports (1000 cubic meters)	Gas Imports expressed in coal equivalence (Ton)	Value of Coal Imports (Net of Production Costs) (USD Real)
2012	300,00	8700,00	4000,00	62911,00	49911,00	2651650,00	943665,00	49911,00	62911,00	1656900,00	0,00	0,00	0,00	0,00
2013	145,00	10000,00	7500,00	63634,48	45989,48	3581935,00	954517,15	45989,48	63634,48	1593265,52	0,00	0,00	0,00	0,00
2014	145,00	10000,00	7500,00	64366,27	46721,27	3581935,00	965494,09	46449,37	64094,37	1528899,25	-271,90	-271,90	-115,18	-13595,09
2015	145,00	10000,00	7500,00	65106,49	47461,49	3581935,00	976597,28	46913,86	64558,86	1463792,77	-547,62	-547,62	-231,98	-27381,01
2016	145,00	25000,00	7500,00	65855,21	33210,21	6626935,00	987828,15	47383,00	80028,00	1397937,56	14172,79	14172,79	6003,87	708639,70
2017	145,00	25000,00	7500,00	67172,31	34527,31	6626935,00	1007584,71	47714,68	80359,68	1330765,24	13187,37	13187,37	5586,43	659368,54
2018	145,00	25000,00	7500,00	68515,76	35870,76	6626935,00	1027736,40	48048,69	80693,69	1262249,48	12177,93	12177,93	5158,81	608896,36
2019	145,00	25000,00	7500,00	69886,08	37241,08	6626935,00	1048291,13	48385,03	81030,03	1192363,41	11143,95	11143,95	4720,79	557197,64
2020	145,00	25000,00	7500,00	71283,80	38638,80	6626935,00	1069256,95	48723,72	81368,72	1121079,61	10084,93	10084,93	4272,17	504246,33
2021	145,00	25000,00	7500,00	72709,47	40064,47	6626935,00	1090642,09	49064,79	81709,79	1048370,14	9000,32	9000,32	3812,71	450015,84
2022	145,00	25000,00	7500,00	73232,98	40587,98	6626935,00	1098494,72	50046,09	82691,09	975137,16	9458,10	9458,10	4006,64	472905,21
2023	145,00	25000,00	7500,00	73760,26	41115,26	6626935,00	1106403,88	51047,01	83692,01	901376,90	9931,75	9931,75	4207,28	496587,43
2024	145,00	25000,00	7500,00	74291,33	41646,33	6626935,00	1114369,99	52067,95	84712,95	827085,56	10421,61	10421,61	4414,80	521080,74
2025	145,00	25000,00	7500,00	74826,23	42181,23	6626935,00	1122393,45	53109,31	85754,31	752259,33	10928,08	10928,08	4629,34	546403,81
2026	145,00	25000,00	7500,00	75364,98	42719,98	6626935,00	1130474,68	54171,49	86816,49	676894,36	11451,51	11451,51	4851,08	572575,67
2027	145,00	25000,00	7500,00	75907,61	43262,61	6626935,00	1138614,10	55254,92	87899,92	600986,75	11992,32	11992,32	5080,18	599615,77
2028	145,00	25000,00	7500,00	76454,14	43809,14	6626935,00	1146812,12	56360,02	89005,02	524532,61	12550,88	12550,88	5316,79	627543,95
2029	145,00	25000,00	7500,00	77004,61	44359,61	6626935,00	1155069,17	57487,22	90132,22	447528,00	13127,61	13127,61	5561,11	656380,48
2030	145,00	25000,00	7500,00	77559,04	44914,04	6626935,00	1163385,67	58636,97	91281,97	369968,95	13722,92	13722,92	5813,29	686146,05
2031	145,00	25000,00	7500,00	78117,47	45472,47	6626935,00	1171762,04	59809,70	92454,70	291851,48	14337,24	14337,24	6073,53	716861,75
2032	145,00	25000,00	7500,00	78679,92	46034,92	6626935,00	1180198,73	61005,90	93650,90	213171,57	14970,98	14970,98	6342,00	748549,17
2033	145,00	25000,00	7500,00	79246,41	46601,41	6626935,00	1188696,16	62226,02	94871,02	133925,16	15624,61	15624,61	6618,89	781230,30
2034	145,00	25000,00	7500,00	79816,98	47171,98	6626935,00	1197254,77	63470,54	96115,54	54108,17	-37809,62	-37809,62	-16016,89	-1890480,98
2035	0,00	0,00	0,00	54108,17	54108,17	0,00	811622,58	64739,95	64739,95	0,00	10631,78	10631,78	4503,83	531588,80
2036	0,00	0,00	0,00	0,00	0,00	0,00	0,00	66034,75	66034,75	0,00	66034,75	27973,60	27973,60	3301737,34
2037	0,00	0,00	0,00	0,00	0,00	0,00	0,00	67355,44	67355,44	0,00	67355,44	28533,07	28533,07	3367772,08
2038	0,00	0,00	0,00	0,00	0,00	0,00	0,00	68702,55	68702,55	0,00	68702,55	29103,73	29103,73	3435127,53
2039	0,00	0,00	0,00	0,00	0,00	0,00	0,00	70076,60	70076,60	0,00	70076,60	29685,80	29685,80	3503830,08
2040	0,00	0,00	0,00	0,00	0,00	0,00	0,00	71478,13	71478,13	0,00	71478,13	30279,52	30279,52	3573906,68
2041	0,00	0,00	0,00	0,00	0,00	0,00	0,00	72907,70	72907,70	0,00	72907,70	30885,11	30885,11	3645384,81
2042	0,00	0,00	0,00	0,00	0,00	0,00	0,00	74365,85	74365,85	0,00	74365,85	31502,81	31502,81	3718292,51
2043	0,00	0,00	0,00	0,00	0,00	0,00	0,00	75853,17	75853,17	0,00	75853,17	2110,24	2110,24	249072,51
2044	0,00	0,00	0,00	0,00	0,00	0,00	0,00	77370,23	77370,23	0,00	77370,23	0,00	0,00	0,00
2045	0,00	0,00	0,00	0,00	0,00	0,00	0,00	78917,64	78917,64	0,00	78917,64	0,00	0,00	0,00
2046	0,00	0,00	0,00	0,00	0,00	0,00	0,00	80495,99	80495,99	0,00	80495,99	0,00	0,00	0,00
2047	0,00	0,00	0,00	0,00	0,00	0,00	0,00	82105,91	82105,91	0,00	82105,91	0,00	0,00	0,00
2048	0,00	0,00	0,00	0,00	0,00	0,00	0,00	83748,03	83748,03	0,00	83748,03	0,00	0,00	0,00
2049	0,00	0,00	0,00	0,00	0,00	0,00	0,00	85422,99	85422,99	0,00	85422,99	0,00	0,00	0,00
2050	0,00	0,00	0,00	0,00	0,00	0,00	0,00	87131,45	87131,45	0,00	87131,45	0,00	0,00	0,00
2051	0,00	0,00	0,00	0,00	0,00	0,00	0,00	88874,07	88874,07	0,00	88874,07	0,00	0,00	0,00
2052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	90651,56	90651,56	0,00	90651,56	0,00	0,00	0,00
2053	0,00	0,00	0,00	0,00	0,00	0,00	0,00	92464,59	92464,59	0,00	92464,59	0,00	0,00	0,00
2054	0,00	0,00	0,00	0,00	0,00	0,00	0,00	94313,88	94313,88	0,00	94313,88	0,00	0,00	0,00
2055	0,00	0,00	0,00	0,00	0,00	0,00	0,00	96200,16	96200,16	0,00	96200,16	0,00	0,00	0,00
2056	0,00	0,00	0,00	0,00	0,00	0,00	0,00	98124,16	98124,16	0,00	98124,16	0,00	0,00	0,00
2057	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100086,64	100086,64	0,00	100086,64	0,00	0,00	0,00
2058	0,00	0,00	0,00	0,00	0,00	0,00	0,00	102088,38	102088,38	0,00	102088,38	0,00	0,00	0,00
2059	0,00	0,00	0,00	0,00	0,00	0,00	0,00	104130,14	104130,14	0,00	104130,14	0,00	0,00	0,00
2060	0,00	0,00	0,00	0,00	0,00	0,00	0,00	106212,75	106212,75	0,00	106212,75	0,00	0,00	0,00
2061	0,00	0,00	0,00	0,00	0,00	0,00	0,00	108337,00	108337,00	0,00	108337,00	0,00	0,00	0,00
2062	0,00	0,00	0,00	0,00	0,00	0,00	0,00	110503,74	110503,74	0,00	110503,74	0,00	0,00	0,00
2063	0,00	0,00	0,00	0,00	0,00	0,00	0,00	112713,82	112713,82	0,00	112713,82	0,00	0,00	0,00
2064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	114968,09	114968,09	0,00	114968,09	0,00	0,00	0,00
2065	0,00	0,00	0,00	0,00	0,00	0,00	0,00	117267,45	117267,45	0,00	117267,45	0,00	0,00	0,00
Total	3.490	173.700	509.000	1.719.811	1.033.621	139.309.220	25.797.165	3.956.920	4.643.110	20.364.449	2.869.190	686.190	290.683	34.309.500

Total Export obligations
686.190

Present Value of Royalty   9.671.588 USD in real terms
Present Value of Coal imports (Net of Production Costs)   5.166.873 USD in real terms
Present Value of Capital Contribution   52.432.170 USD in real terms

Appendix 1: (cont'd)

Scenario 1. Best-Best-Low

SENSITIVITY ANALYSIS

Real Discount rate WACC	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
4%	19.715.276,51	15.287.268,23	108.235.716,42	4.428.008,28
5%	17.006.977,22	12.758.541,41	93.379.119,63	4.248.435,82
6%	15.000.645,25	10.741.668,06	82.308.956,37	4.258.977,19
7%	13.457.869,73	9.123.072,66	73.743.320,21	4.334.797,08
8%	12.231.320,13	7.815.825,72	66.890.472,49	4.415.494,42
9%	11.228.072,24	6.753.129,39	61.251.226,63	4.474.942,86
10%	10.388.105,40	5.883.450,73	56.503.154,00	4.504.654,67
11%	9.671.588,26	5.166.873,39	52.432.169,97	4.504.714,86
12%	9.051.289,82	4.572.353,24	48.891.736,67	4.478.936,58
13%	8.508.000,57	4.075.646,85	45.778.275,22	4.432.353,71
14%	8.027.735,18	3.657.742,65	43.016.164,17	4.369.992,53
15%	7.599.998,75	3.303.668,62	40.548.454,59	4.296.330,13

Real Well-head Price of Gas (USD)	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
35	6.770.111,78	3.616.811,37	56.306.464,54	3.153.300,40
40	7.737.270,60	4.133.498,71	55.015.033,02	3.603.771,89
45	8.704.429,43	4.650.186,05	53.723.601,49	4.054.243,38
50	9.671.588,26	5.166.873,39	52.432.169,97	4.504.714,86
55	10.638.747,08	5.683.560,73	51.140.738,45	4.955.186,35
60	11.605.905,91	6.200.248,07	49.849.306,92	5.405.657,84
65	12.573.064,73	6.716.935,41	48.557.875,40	5.856.129,32
70	13.540.223,56	7.233.622,75	47.266.443,88	6.306.600,81
75	14.507.382,38	7.750.310,09	45.975.012,35	6.757.072,30

Percentage Change of Real Export Prices	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
-10%	9.671.588,26	5.166.873,39	41.583.502,48	4.504.714,86
-5%	9.671.588,26	5.166.873,39	46.887.966,03	4.504.714,86
-2%	9.671.588,26	5.166.873,39	50.185.719,55	4.504.714,86
-1%	9.671.588,26	5.166.873,39	51.304.149,95	4.504.714,86
0%	9.671.588,26	5.166.873,39	52.432.169,97	4.504.714,86
1%	9.671.588,26	5.166.873,39	53.569.779,61	4.504.714,86
2%	9.671.588,26	5.166.873,39	54.716.978,86	4.504.714,86
5%	9.671.588,26	5.166.873,39	58.216.114,30	4.504.714,86
10%	9.671.588,26	5.166.873,39	64.239.799,02	4.504.714,86

APPENDIX 2
Scenario 1a. High-Low-Low

TABLE OF PARAMETERS

Prices, as of 2012

Well Head Price of gas	50,00	USD / 1000 m3
Well head price of natural gas in Coal equivalence	118,03	USD / Ton of coal (including transportation cost)
Percentage Change of Real Export Prices	0%	*Base case scenario

Royalty Rate

	30%	"Uztrangas" JS Company
WACC	11%	*estimated (not constant over time)

Kwh generated per unit of fuel used	1870	kWh per Ton of Coal
	125	kwh per 1000 cubic feet of natural gas

Conversi		
on Factor	0,423619328	Ton of Coal per 1000 cm of Natural Gas

Production Costs

Production Cost	35,00	($/1000m3)
Production cost in coal equivalence / ton	82,6	($/Ton of coal)
Worth of 1 Ton coal in terms of Well Head Price net of Production costs of Natural Gas	35,4	($/Ton of coal)

	Bmc	Probability	Recoverable Reserves (bmc)
Total Proven Reserves	1.841,00	90%	1.656,90
Probable Natural Gas Resources	2.100,00	50%	1.050,00
Possible Natural Gas Resources	5.900,00	10%	590,00

Conversions

1 bmc (billion cubic metres)	1.000.000.000	mc (cubic metre)
1000 m3 or thousand mc	1.000	cubic metres
1 cubic foot	0,0283168	cubic metres
1 Tcf (Trillion cubic feet)	28,3	bmc

UZBEKISTAN NATURAL GAS DEMAND/SUPPLY FORECAST

	Data as of Year 2012			
	Russia	Tajikistan	Kyrgyzistan	China
Export Price ($/1000m3)	253	253	300	290
Export Volume (bcm)		8,7	0,155	0,145
Total RevUSD	2.201.100.000	46.500.000	42.050.000	560.000.000
Contribution of Export Price to Capital Recovery (per 1000m3) As of **2012**		203,00	250,00	240,00
Total Value of Contribution USD	1.766.100	38.750	34.800	360.000

*Demand/Supply assumptions table	Russia	Tajikistan	Kyrgyzistan	China	Supply (Production)	Domestic Demand	Export Capacity
Total Volume (1000 m3 as of 2012)	8.700	155	145	4.000	62.911	49.911	13.000
Total Volume (1000 m3 as of 2013)	7.500	0,00	145	10.000	63.634	45.989	17.645
Short term annual growth rate (2012-2016)	0%	0%	0%	0%	1,15%	1,00%	1,72%
Medium term annual growth rate (2016-2021)	0%	0%	0%	25.000	2,0%	0,70%	7,76%
Longer term annual growth rate (up to 2050)	0%	0%	0%	0%	-1%	3%	#NUM!

	Data as of Year 2013			
	Russia	Tajikistan	Kyrgyzistan	China
	253	253	300	253
		7,5	0	0,145
	1.897.500.000	36.685.000		2.530.000.000
		203,00	250,00	203,00
	1.522.500	29.435	0	2.030.000

APPENDIX 2: (cont'd)
Scenario 1a. High-Low-Low

Cost-Benefit Analysis of Natural Gas Exports

Year	Quantity of Gas Supplied to Tajikistan and Kyrgyzstan (1000 cubic meters)	Quantity of Gas Supplied to Russia (1000 cubic meters)	Quantity of Gas Supplied to China (1000 cubic meters)	Supply (Total Volume of Gas Production) (1000 cubic meters)	Quantity of Gas Supplied to Domestic Market (1000 cubic meters)	Value of Exports Net of Wellhead Price and transport cost (USD Real)	Royalty Payment (USD Real)	Domestic Demand Natural Gas (1000 cubic meters)	Domestic Demand plus Export Demand Natural Gas (1000 cubic meters)	Available Proven Reserves (1000 cubic meters)	Amount Needed to Meet Domestic Volume of Gas Demand (1000 cubic meters)	Quantity of Required Gas Imports (1000 cubic meters)	Gas Imports expressed in real equivalence (Ton)	Value of Coal Imports (Net of Production Costs) (USD Real)
2012	300,00	8700,00	4000,00	62911,00	49911,00	2199650,00	943665,00	49911,00	62911,00	1656900,00	0,00	0,00	0,00	0,00
2013	145,00	7500,00	10000,00	63634,48	45989,48	3581935,00	954517,15	45989,48	63634,48	1593265,52	0,00	0,00	0,00	0,00
2014	145,00	7500,00	10000,00	64366,27	46721,27	3581935,00	965494,09	46649,37	64094,37	1528899,25	-271,90	-271,90	-115,18	-13595,09
2015	145,00	7500,00	10000,00	65106,49	47461,49	3581935,00	976597,28	46913,86	64558,86	1463792,77	-547,62	-547,62	-231,98	-27381,01
2016	145,00	7500,00	25000,00	65855,21	33210,21	6626935,00	987828,15	47383,00	80028,00	1397937,56	14172,79	14172,79	6003,87	708639,70
2017	145,00	7500,00	25000,00	67172,31	34527,31	6626935,00	1007584,71	47714,68	80359,68	1330765,24	13187,37	13187,37	5586,43	659368,54
2018	145,00	7500,00	25000,00	68515,76	35870,76	6626935,00	1027736,40	48048,69	80693,69	1262249,48	12177,93	12177,93	5158,81	608896,36
2019	145,00	7500,00	25000,00	69886,08	37241,08	6626935,00	1048291,13	48385,03	81030,03	1192363,41	11143,95	11143,95	4720,79	557197,64
2020	145,00	7500,00	25000,00	71283,80	38638,80	6626935,00	1069256,95	48723,72	81368,72	1121079,61	10084,93	10084,93	4272,17	504246,33
2021	145,00	7500,00	25000,00	72709,47	40064,47	6626935,00	1090642,09	49064,79	81709,79	1048370,14	9000,32	9000,32	3812,71	450015,84
2022	145,00	7500,00	25000,00	71975,11	39330,11	6626935,00	1079626,61	50492,57	83137,57	976395,03	11162,47	11162,47	4728,64	558123,39
2023	145,00	7500,00	25000,00	71248,16	38603,16	6626935,00	1068722,38	51961,91	84606,91	905146,87	13358,75	13358,75	5659,02	667937,51
2024	145,00	7500,00	25000,00	70528,55	37883,55	6626935,00	1057928,28	53474,00	86119,00	834618,32	15590,45	15590,45	6604,42	779522,41
2025	145,00	7500,00	25000,00	69816,21	37171,21	6626935,00	1047243,21	55030,09	87675,09	764802,10	17858,88	17858,88	7565,37	892944,00
2026	145,00	7500,00	25000,00	69111,07	36466,07	6626935,00	1036666,05	56631,47	89276,47	695691,03	20165,40	20165,40	8542,45	1008269,97
2027	145,00	7500,00	25000,00	68413,05	35768,05	6626935,00	1026195,72	58279,45	90924,45	627277,99	22511,40	22511,40	9536,26	1125569,85
2028	145,00	7500,00	25000,00	67722,08	35077,08	6626935,00	1015831,15	59975,38	92620,38	559555,91	24898,30	24898,30	10547,40	1244915,04
2029	145,00	7500,00	25000,00	67038,08	34393,08	6626935,00	1005571,25	61720,66	94365,66	492517,83	27327,58	27327,58	11576,49	1366378,86
2030	145,00	7500,00	25000,00	66361,00	33716,00	6626935,00	995414,98	63516,73	96161,73	426156,83	29800,73	29800,73	12624,17	1490036,65
2031	145,00	7500,00	25000,00	65690,75	33045,75	6626935,00	985361,29	65365,07	98010,07	360466,08	32319,32	32319,32	13691,09	1615965,80
2032	145,00	7500,00	25000,00	65027,28	32382,28	6626935,00	975409,14	67267,19	99912,19	295438,80	34884,92	34884,92	14777,92	1744245,81
2033	145,00	7500,00	25000,00	64370,50	31725,50	6626935,00	965557,51	69224,67	101869,67	231068,30	37499,17	37499,17	15885,37	1874958,34
2034	145,00	7500,00	25000,00	63720,36	31075,36	6626935,00	955805,38	71239,11	103884,11	167347,94	40163,75	40163,75	17014,14	2008187,34
2035	145,00	7500,00	25000,00	63076,78	30431,78	6626935,00	946151,74	73312,16	105957,16	104271,16	42880,38	42880,38	18164,96	2144019,02
2036	145,00	7500,00	25000,00	62439,71	29794,71	6626935,00	936595,61	75445,55	108090,55	41831,45	3819,39	3819,39	1617,97	190969,51
2037	0,00	0,00	0,00	41831,45	41831,45	0,00	627471,74	77641,01	77641,01	41831,45	35809,56	35809,56	15169,62	1790478,16
2038	0,00	0,00	0,00	0,00	0,00	0,00	0,00	79900,37	79900,37	0,00	79900,37	79900,37	33847,34	3995018,31
2039	0,00	0,00	0,00	0,00	0,00	0,00	0,00	82225,47	82225,47	0,00	82225,47	82225,47	34832,30	4111273,34
2040	0,00	0,00	0,00	0,00	0,00	0,00	0,00	84618,23	84618,23	0,00	84618,23	84618,23	35845,92	4230911,39
2041	0,00	0,00	0,00	0,00	0,00	0,00	0,00	87080,62	87080,62	0,00	87080,62	25737,74	10903,00	1286886,98
2042	0,00	0,00	0,00	0,00	0,00	0,00	0,00	89614,66	89614,66	0,00	89614,66	0,00	0,00	0,00
2043	0,00	0,00	0,00	0,00	0,00	0,00	0,00	92222,45	92222,45	0,00	92222,45	0,00	0,00	0,00
2044	0,00	0,00	0,00	0,00	0,00	0,00	0,00	94906,12	94906,12	0,00	94906,12	0,00	0,00	0,00
2045	0,00	0,00	0,00	0,00	0,00	0,00	0,00	97667,89	97667,89	0,00	97667,89	0,00	0,00	0,00
2046	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100510,03	100510,03	0,00	100510,03	0,00	0,00	0,00
2047	0,00	0,00	0,00	0,00	0,00	0,00	0,00	103434,87	103434,87	0,00	103434,87	0,00	0,00	0,00
2048	0,00	0,00	0,00	0,00	0,00	0,00	0,00	106444,82	106444,82	0,00	106444,82	0,00	0,00	0,00
2049	0,00	0,00	0,00	0,00	0,00	0,00	0,00	109542,37	109542,37	0,00	109542,37	0,00	0,00	0,00
2050	0,00	0,00	0,00	0,00	0,00	0,00	0,00	112730,05	112730,05	0,00	112730,05	0,00	0,00	0,00
2051	0,00	0,00	0,00	0,00	0,00	0,00	0,00	116010,50	116010,50	0,00	116010,50	0,00	0,00	0,00
2052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	119386,40	119386,40	0,00	119386,40	0,00	0,00	0,00
2053	0,00	0,00	0,00	0,00	0,00	0,00	0,00	122860,55	122860,55	0,00	122860,55	0,00	0,00	0,00
2054	0,00	0,00	0,00	0,00	0,00	0,00	0,00	126435,79	126435,79	0,00	126435,79	0,00	0,00	0,00
2055	0,00	0,00	0,00	0,00	0,00	0,00	0,00	130115,07	130115,07	0,00	130115,07	0,00	0,00	0,00
2056	0,00	0,00	0,00	0,00	0,00	0,00	0,00	133901,42	133901,42	0,00	133901,42	0,00	0,00	0,00
2057	0,00	0,00	0,00	0,00	0,00	0,00	0,00	137797,95	137797,95	0,00	137797,95	0,00	0,00	0,00
2058	0,00	0,00	0,00	0,00	0,00	0,00	0,00	141807,87	141807,87	0,00	141807,87	0,00	0,00	0,00
2059	0,00	0,00	0,00	0,00	0,00	0,00	0,00	145934,48	145934,48	0,00	145934,48	0,00	0,00	0,00
2060	0,00	0,00	0,00	0,00	0,00	0,00	0,00	150181,17	150181,17	0,00	150181,17	0,00	0,00	0,00
2061	0,00	0,00	0,00	0,00	0,00	0,00	0,00	154551,44	154551,44	0,00	154551,44	0,00	0,00	0,00
2062	0,00	0,00	0,00	0,00	0,00	0,00	0,00	159048,89	159048,89	0,00	159048,89	0,00	0,00	0,00
2063	0,00	0,00	0,00	0,00	0,00	0,00	0,00	163677,21	163677,21	0,00	163677,21	0,00	0,00	0,00
2064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	168440,22	168440,22	0,00	168440,22	0,00	0,00	0,00
2065	0,00	0,00	0,00	0,00	0,00	0,00	0,00	173341,83	173341,83	0,00	173341,83	0,00	0,00	0,00
Total	3.780	188.700	559.000	1.719.811	968.331	152.111.090	25.797.165	4.873.549	5.625.029	21.078.209	3.863.387	751.480	318.341	37.574.000

751.480

Total Export obligations: 751.480

Present Value of Royalty: 9.515.711 USD in real terms
Present Value of Coal Imports (Net of Production Costs): 6.474.644 USD in real terms
Present Value of Capital Contribution: 53.751.026 USD in real terms

Appendix 2: (cont'd)

Scenario 1a. High-Low-Low

SENSITIVITY ANALYSIS

Real Discount rate WACC	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
4%	19.517.473,80	18.077.969,52	115.322.133,73	1.439.504,28
5%	16.801.746,94	15.310.542,60	98.766.439,43	1.491.204,34
6%	14.795.684,07	13.053.347,58	86.466.407,19	1.742.336,49
7%	13.258.343,94	11.202.436,45	76.991.796,79	2.055.907,49
8%	12.040.560,88	9.676.508,75	69.454.780,37	2.364.052,13
9%	11.048.090,19	8.411.717,21	63.292.483,43	2.636.372,98
10%	10.219.970,87	7.357.716,17	58.139.263,59	2.862.254,70
11%	9.515.711,34	6.474.644,33	53.751.025,60	3.041.067,01
12%	8.907.625,91	5.730.812,74	49.959.920,78	3.176.813,17
13%	8.376.200,57	5.100.926,60	46.646.921,06	3.275.273,97
14%	7.907.254,49	4.564.712,87	43.724.994,23	3.342.541,63
15%	7.490.175,74	4.105.857,23	41.128.623,81	3.384.318,51

Real Well-head Price of Gas (USD)	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
35	6.660.997,94	4.532.251,03	57.722.904,88	2.128.746,91
40	7.612.569,07	5.179.715,47	56.398.945,12	2.432.853,61
45	8.564.140,21	5.827.179,90	55.074.985,36	2.736.960,31
50	9.515.711,34	6.474.644,33	53.751.025,60	3.041.067,01
55	10.467.282,47	7.122.108,77	52.427.065,85	3.345.173,71
60	11.418.853,61	7.769.573,20	51.103.106,09	3.649.280,41
65	12.370.424,74	8.417.037,63	49.779.146,33	3.953.387,11
70	13.321.995,88	9.064.502,07	48.455.186,57	4.257.493,81
75	14.273.567,01	9.711.966,50	47.131.226,81	4.561.600,51

Percentage Change of Real Export Prices	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
-10%	9.515.711,34	6.474.644,33	42.623.664,50	3.041.067,01
-5%	9.515.711,34	6.474.644,33	48.064.305,39	3.041.067,01
-2%	9.515.711,34	6.474.644,33	51.446.808,00	3.041.067,01
-1%	9.515.711,34	6.474.644,33	52.593.995,22	3.041.067,01
0%	9.515.711,34	6.474.644,33	53.751.025,60	3.041.067,01
1%	9.515.711,34	6.474.644,33	54.917.899,17	3.041.067,01
2%	9.515.711,34	6.474.644,33	56.094.615,90	3.041.067,01
5%	9.515.711,34	6.474.644,33	59.683.825,13	3.041.067,01
10%	9.515.711,34	6.474.644,33	65.862.703,98	3.041.067,01

APPENDIX 3
Scenario 1b. Low-High-Low

TABLE OF PARAMETERS

Prices, as of 2012

Well Head Price of gas	50,00	USD / 1000 m3
Well head price of natural gas in Coal equivalence	118,03	USD / Ton of coal (including transportation cost)
Percentage Change of Real Export Prices	0%	*Base case scenario

Royalty Rate

	30%	"Uztransgas" JS Company
WACC	11%	*estimated (not constant over time)

Kwh generated per unit of fuel used	1870	kWh per Ton of Coal
	12,5	kwh per 1000 cubic feet of natural gas

Conversion		
Factor	0,423619328	Ton of Coal per 1000 cm of Natural Gas

Production Costs

Production Cost	35,00	($/1000m3)
Production cost in coal equivalence / ton	82,6	($/Ton of coal)
Worth of 1 Ton coal in terms of Well Head Price net of Production costs of Natural Gas	35,4	($/Ton of coal)

	Bmc	Probability	Recoverable Reserves (bmc)
Total Proven Reserves	1.841,00	90%	1.656,90
Probable Natural Gas Resources	2.100,00	50%	1.050,00
Possible Natural Gas Resources	5.900,00	10%	590,00

Conversions

1 bmc (billion cubic metres)	1.000.000.000	mc (cubic metre)
1000 m3 or thousand mc	1.000	cubic metres
1 cubic foot	0,0283168	cubic metres
1 Tcf (Trillion cubic feet)	28,3	bmc

UZBEKISTAN NATURAL GAS DEMAND/SUPPLY MODULE

	Data as of Year 2012				
	Russia	Tajikistan	Kyrgyzistan	China	
Export Price ($/1000m3)	253	253	300	290	140
Export Volume (bcm)	8,7	0,155	0,155	0,145	4
Total Revenue USD	2.201.100.000	46.500.000	42.050.000	560.000.000	

Contribution of Export Price to Capital Recovery (per 1000m3) As of 2012	203,00	250,00	240,00	90,00

Total Value of Contribution USD	1.766.100	38.750	34.800	360.000

*Demand/Supply assumptions table	Russia	Tajikistan	Kyrgyzistan	China	Supply (Production)
Total Volume (1000 m3 as of 2012)	8.700	155	145	4.000	62.911
Total Volume (1000 m3 as of 2013)	7.500	0,00	145	10.000	63.634
Short term annual growth rate (2012-2016)	0%	0%	0%	0%	1,15%
Medium term annual growth rate (2016-2021)	0%	0%	0%	25.000	2,0%
Longer term annual growth rate (up to 2050)	0%	0%	0%	0%	0,9%

	Data as of Year 2013			
	Russia	Tajikistan	Kyrgyzistan	China
	253	253	300	253
	7,5	0,145	0	0,145	10
	################		0	36.685.000	2.530.000.000

	203,00	250,00	0	203,00

	1.522.500	0	29.435	2.030.000

Domestic Demand	Export Capacity
49.911	13.000
45.989	17.645
1,00%	1,72%
0,70%	7,76%
-1%	14,52%

Cost-Benefit Analysis of Natural Gas Exports

Year	Quantity of Gas Supplied to Tajikistan and Kyrgyzstan (1000 cubic meters)	Quantity of Gas Supplied to Russia (1000 cubic meters)	Quantity of Gas Supplied to China (1000 cubic meters)	Supply (Total Volume of Gas Production) (1000 cubic meters)	Quantity of Gas Supplied to Domestic Market (1000 cubic meters)	Value of Exports Net of Wellhead Price and transport cost (USD Real)	Royalty Payment (USD Real)	Domestic Demand Natural Gas (1000 cubic meters)	Domestic Demand plus Export Demand Natural Gas (1000 cubic meters)	Available "IP" Reserves (1000 cubic meters)	Amount Needed to Meet Domestic Volume of Gas Demand (1000 cubic meters)	Quantity of Required Gas Imports (1000 cubic meters)	Gas Imports expressed in coal equivalence (Ton)	Value of Coal Imports (Net of Production Costs) (USD Real)
2012	300,00	8700,00	4000,00	62911,00	49911,00	2199650,00	943665,00	49911,00	62911,00	1656900,00	0,00	0,00	0,00	0,00
2013	145,00	7500,00	10000,00	63634,48	45989,48	3581935,00	954517,15	45989,48	63634,48	1593265,52	0,00	0,00	0,00	0,00
2014	145,00	7500,00	10000,00	64366,27	46721,27	3581935,00	965494,09	46449,37	64094,37	1528899,25	-271,90	-271,90	-115,18	-13595,09
2015	145,00	7500,00	10000,00	65106,49	47461,49	3581935,00	976597,28	46913,86	64558,86	1463792,77	-547,62	-547,62	-231,98	-27381,01
2016	145,00	7500,00	25000,00	65855,21	33210,21	6626935,00	987828,15	47383,00	80028,00	1397937,56	14172,79	14172,79	6003,87	708639,70
2017	145,00	7500,00	25000,00	67172,31	34527,31	6626935,00	1007584,71	47714,68	80359,68	1330765,24	13187,37	13187,37	5586,43	659368,54
2018	145,00	7500,00	25000,00	68515,76	35870,76	6626935,00	1027736,40	48048,69	80693,69	1262249,48	12177,93	12177,93	5158,81	608896,36
2019	145,00	7500,00	25000,00	69886,08	37241,08	6626935,00	1048291,13	48385,03	81030,03	1193363,41	11143,95	11143,95	4720,79	557197,64
2020	145,00	7500,00	25000,00	71283,80	38638,80	6626935,00	1069256,95	48723,72	81368,72	1121079,61	10084,93	10084,93	4272,17	504246,33
2021	145,00	7500,00	25000,00	72709,47	40064,47	6626935,00	1090642,09	49064,79	81709,79	1048370,14	9000,32	9000,32	3812,71	450015,84
2022	145,00	7500,00	25000,00	73356,59	40711,59	6626935,00	1100348,81	48422,04	81067,04	975013,55	7710,45	7710,45	3266,30	385522,68
2023	145,00	7500,00	25000,00	74009,46	41364,46	6626935,00	1110141,91	47787,71	80432,71	901004,09	6423,25	6423,23	2721,01	321162,56
2024	145,00	7500,00	25000,00	74668,14	42023,14	6626935,00	1120022,17	47161,69	79806,69	826335,94	5138,55	5138,55	2176,79	256927,40
2025	145,00	7500,00	25000,00	75332,69	42687,69	6626935,00	1129990,37	46543,87	79188,87	751003,25	3856,18	3856,18	1633,55	192809,17
2026	145,00	7500,00	25000,00	76003,15	43358,15	6626935,00	1140047,29	45934,15	78579,15	675000,10	2576,00	2576,00	1091,24	128799,88
2027	145,00	7500,00	25000,00	76679,58	44034,58	6626935,00	1150193,71	45332,41	77977,41	598320,52	1297,83	1297,83	549,79	64891,61
2028	145,00	7500,00	25000,00	77362,04	44717,03	6626935,00	1160430,43	44738,56	77383,56	520958,49	21,53	21,53	9,12	1076,47
2029	145,00	7500,00	25000,00	78050,55	45405,55	6626935,00	1170758,26	44152,48	76797,48	442907,94	-1253,07	-1253,07	-530,82	-62653,39
2030	145,00	7500,00	25000,00	78745,20	46100,20	6626935,00	1181178,01	43574,09	76219,09	364162,74	-2526,12	-2526,12	-1070,11	-126305,76
2031	145,00	7500,00	25000,00	79446,26	46801,03	6626935,00	1191690,49	43003,26	75648,26	284716,71	-3797,77	-3797,77	-1608,81	-189888,40
2032	145,00	7500,00	25000,00	80153,10	47508,10	6626935,00	1202296,54	42439,92	75084,92	204563,60	-5068,18	-5068,18	-2146,98	-253409,02
2033	145,00	7500,00	25000,00	80866,47	48221,47	6626935,00	1212996,98	41883,96	74528,96	123697,14	-6337,51	-6337,51	-2684,69	-316875,30
2034	145,00	7500,00	25000,00	81586,18	48941,18	6626935,00	1223792,65	41335,28	73980,28	42110,96	-7605,90	-7605,90	-3222,01	-380294,87
2035	0,00	0,00	0,00	42110,96	42110,96	0,00	631664,42	40793,79	40793,79	0,00	-1317,17	-1317,17	-557,98	-65858,72
2036	0,00	0,00	0,00	0,00	0,00	0,00	0,00	40259,39	40259,39	0,00	40259,39	40259,39	17054,66	2012969,43
2037	0,00	0,00	0,00	0,00	0,00	0,00	0,00	39731,99	39731,99	0,00	39731,99	39731,99	16831,24	1986599,53
2038	0,00	0,00	0,00	0,00	0,00	0,00	0,00	39211,50	39211,50	0,00	39211,50	39211,50	16610,75	1960575,07
2039	0,00	0,00	0,00	0,00	0,00	0,00	0,00	38697,83	38697,83	0,00	38697,83	38697,83	16393,15	1934891,54
2040	0,00	0,00	0,00	0,00	0,00	0,00	0,00	38190,89	38190,89	0,00	38190,89	38190,89	16178,40	1909544,46
2041	0,00	0,00	0,00	0,00	0,00	0,00	0,00	37690,59	37690,59	0,00	37690,59	37690,59	15966,46	1884529,43
2042	0,00	0,00	0,00	0,00	0,00	0,00	0,00	37196,84	37196,84	0,00	37196,84	37196,84	15757,30	1859842,09
2043	0,00	0,00	0,00	0,00	0,00	0,00	0,00	36709,56	36709,56	0,00	36709,56	36709,56	15550,88	1835478,16
2044	0,00	0,00	0,00	0,00	0,00	0,00	0,00	36228,67	36228,67	0,00	36228,67	36228,67	15347,16	1811433,40
2045	0,00	0,00	0,00	0,00	0,00	0,00	0,00	35754,07	35754,07	0,00	35754,07	35754,07	15146,12	1787703,62
2046	0,00	0,00	0,00	0,00	0,00	0,00	0,00	35285,69	35285,69	0,00	35285,69	35285,69	14947,70	1764284,70
2047	0,00	0,00	0,00	0,00	0,00	0,00	0,00	34823,45	34823,45	0,00	34823,45	34823,45	14751,89	1741172,57
2048	0,00	0,00	0,00	0,00	0,00	0,00	0,00	34367,26	34367,26	0,00	34367,26	34367,26	14558,64	1718363,21
2049	0,00	0,00	0,00	0,00	0,00	0,00	0,00	33917,05	33917,05	0,00	33917,05	33917,05	14367,92	1695852,66
2050	0,00	0,00	0,00	0,00	0,00	0,00	0,00	33472,74	33472,74	0,00	33472,74	33472,74	14179,70	1673636,99
2051	0,00	0,00	0,00	0,00	0,00	0,00	0,00	33034,25	33034,25	0,00	33034,25	33034,25	13993,95	1651712,34
2052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	32601,50	32601,50	0,00	32601,50	32601,50	13810,62	1630074,91
2053	0,00	0,00	0,00	0,00	0,00	0,00	0,00	32174,42	32174,42	0,00	32174,42	950,87	402,80	47543,25
2054	0,00	0,00	0,00	0,00	0,00	0,00	0,00	31752,93	31752,93	0,00	31752,93	0,00	0,00	0,00
2055	0,00	0,00	0,00	0,00	0,00	0,00	0,00	31336,97	31336,97	0,00	31336,97	0,00	0,00	0,00
2056	0,00	0,00	0,00	0,00	0,00	0,00	0,00	30926,46	30926,46	0,00	30926,46	0,00	0,00	0,00
2057	0,00	0,00	0,00	0,00	0,00	0,00	0,00	30521,32	30521,32	0,00	30521,32	0,00	0,00	0,00
2058	0,00	0,00	0,00	0,00	0,00	0,00	0,00	30121,49	30121,49	0,00	30121,49	0,00	0,00	0,00
2059	0,00	0,00	0,00	0,00	0,00	0,00	0,00	29726,90	29726,90	0,00	29726,90	0,00	0,00	0,00
2060	0,00	0,00	0,00	0,00	0,00	0,00	0,00	29337,48	29337,48	0,00	29337,48	0,00	0,00	0,00
2061	0,00	0,00	0,00	0,00	0,00	0,00	0,00	28953,16	28953,16	0,00	28953,16	0,00	0,00	0,00
2062	0,00	0,00	0,00	0,00	0,00	0,00	0,00	28573,87	28573,87	0,00	28573,87	0,00	0,00	0,00
2063	0,00	0,00	0,00	0,00	0,00	0,00	0,00	28199,55	28199,55	0,00	28199,55	0,00	0,00	0,00
2064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	27830,14	27830,14	0,00	27830,14	0,00	0,00	0,00
2065	0,00	0,00	0,00	0,00	0,00	0,00	0,00	27465,56	27465,56	0,00	27465,56	0,00	0,00	0,00
Total	3.490	173.700	509.000	1.719.811	1.033.621	138.857.220	25.797.165	2.105.780	2.791.970	20.305.418	1.072.159	686.190	290.683	34.309.500

Total Export obligations
686.190

Present Value of Royalty 9.685.516 USD in real terms
Present Value of Coal imports (Net of Production Costs) 3.701.766 USD in real terms
Present Value of Capital Contribution 52.430.379 USD in real terms

Appendix 3: (cont'd)

Scenario 1b. Low-High-Low

SENSITIVITY ANALYSIS

Real Discount rate WACC	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
4%	19.732.157,21	12.480.204,46	108.179.174,38	7.251.952,75
5%	17.024.619,12	10.039.018,88	93.345.070,53	6.985.600,24
6%	15.018.387,93	8.196.770,15	82.288.353,50	6.821.617,79
7%	13.475.259,36	6.794.069,09	73.730.794,62	6.681.190,27
8%	12.248.054,96	5.715.942,23	66.882.822,18	6.532.112,72
9%	11.243.961,80	4.879.007,85	61.246.532,73	6.364.953,95
10%	10.403.039,89	4.222.470,61	56.500.261,15	6.180.569,29
11%	9.685.515,73	3.701.765,59	52.430.379,28	5.983.750,14
12%	9.064.199,11	3.284.049,62	48.890.623,45	5.780.149,49
13%	8.519.908,70	2.944.987,28	45.777.580,22	5.574.921,42
14%	8.038.678,02	2.666.448,55	43.015.728,47	5.372.229,46
15%	7.610.024,16	2.434.851,72	40.548.180,34	5.175.172,44

Real Well-head Price of Gas (USD)	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
35	6.779.861,01	2.591.235,91	56.304.673,85	4.188.625,10
40	7.748.412,58	2.961.412,47	55.013.242,33	4.787.000,12
45	8.716.964,16	3.331.589,03	53.721.810,80	5.385.375,13
50	9.685.515,73	3.701.765,59	52.430.379,28	5.983.750,14
55	10.654.067,30	4.071.942,14	51.138.947,76	6.582.125,16
60	11.622.618,88	4.442.118,70	49.847.516,23	7.180.500,17
65	12.591.170,45	4.812.295,26	48.556.084,71	7.778.875,19
70	13.559.722,02	5.182.471,82	47.264.653,19	8.377.250,20
75	14.528.273,60	5.552.648,38	45.973.221,66	8.975.625,22

Percentage Change of Real Export Prices	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
-10%	9.685.515,73	3.701.765,59	41.581.711,79	5.983.750,14
-5%	9.685.515,73	3.701.765,59	46.886.175,34	5.983.750,14
-2%	9.685.515,73	3.701.765,59	50.183.928,86	5.983.750,14
-1%	9.685.515,73	3.701.765,59	51.302.359,26	5.983.750,14
0%	9.685.515,73	3.701.765,59	52.430.379,28	5.983.750,14
1%	9.685.515,73	3.701.765,59	53.567.988,92	5.983.750,14
2%	9.685.515,73	3.701.765,59	54.715.188,17	5.983.750,14
5%	9.685.515,73	3.701.765,59	58.214.323,61	5.983.750,14
10%	9.685.515,73	3.701.765,59	64.238.008,32	5.983.750,14

APPENDIX 4
Scenario 2. Best-Best-Best

TABLE OF PARAMETERS

Prices, as of 2012

Well Head Price of gas	50,00	USD / 1000 m3
Well head price of natural gas in Coal equivalence	118,03	USD / Ton of coal (including transportation cost)
Percentage Change of Real Export Prices	0%	*Base case scenario

Royalty Rate

	30%	"Uztransgas" JS Company
WACC	11%	*estimated (not constant over time)

Kwh generated per unit of fuel used	1870	kWh per Ton of Coal
	125	kwh per 1000 cubic feet of natural gas

Conversion		
Factor	0,423619328	Ton of Coal per 1000 cm of Natural Gas

Production Costs

Production Cost	35,00	($/1000m3)
Production cost in coal equivalence / ton	82,6	($/Ton of coal)
Worth of 1 Ton coal in terms of Well Head Price net of Production costs of Natural Gas	35,4	($/Ton of coal)

	Bmc	Probability	Recoverable Reserves (bmc)
Total Proven Reserves	1.841,00	90%	1.656,90
Probable Natural Gas Resources	2.100,00	50%	1.050,00
Possible Natural Gas Resources	5.900,00	10%	590,00

Conversions

1 bmc (billion cubic metres)	1.000.000.000	mc (cubic metre)
1000 m3 or thousand mc	1.000	cubic metres
1 cubic foot	0,0283168	cubic metres
1 Tcf (Trillion cubic feet)	28,3	bmc

UZBEKISTAN NATURAL GAS DEMAND/SUPPLY MODULE

	Data as of Year 2012			
	Russia	Tajikistan	Kyrgyzistan	China
Export Price ($/1000m3)	253	253	300	290
Export Volume (bcm)	8,7	0,155	0,145	
Total Revenu USD	2.201.100.000	46.500.000	42.050.000	560.000.000

				140
				4

Contribution of Export Price to Capital Recovery (per 1000m3) As of 2012	203,00	203,00	250,00	240,00

				90,00

Total Value of Contribution USD	1.766.100	38.750	34.800	360.000

*Demand/Supply assumptions table	Russia	Tajikistan	Kyrgyzistan	China	Supply (Production)	Domestic Demand	Export Capacity
Total Volume (1000 m3 as of 2012)	8.700	155	145	145	62.911	49.911	13.000
Total Volume (1000 m3 as of 2013)	7.500	0,00		145	63.634	45.989	17.645
Short term annual growth rate (2012-2016)	0%	0%	0%	0%	1,15%	1,00%	1,72%
Medium term annual growth rate (2016-2021)	0%	0%	0%	0%	2,0%	0,70%	7,76%
Longer term annual growth rate (up to 2050)	0%	0%	0%	0%	0,72%	2%	1,42%

	Data as of Year 2013			
	Russia	Tajikistan	Kyrgyzistan	China
Export Price ($/1000m3)	253	253	300	253
Export Volume (bcm)	7,5		0	0,145
Total Revenu USD	1.897.500.000		36.685.000	2.530.000.000

				10

	203,00	203,00	250,00	203,00

	1.522.500		29.435	2.030.000

Cost-Benefit Analysis of Natural Gas Exports

Year	Quantity of Gas Supplied to Tajikistan and Kyrgyzstan (1000 cubic meters)	Quantity of Gas Supplied to Russia (1000 cubic meters)	Quantity of Gas Supplied to China (1000 cubic meters)	Supply (Total Volume of Gas Production) (1000 cubic meters)	Quantity of Gas Supplied to Domestic Market (1000 cubic meters)	Value of Exports Net of Wellhead Price and transport cost (USD Real)	Royalty Payment (USD Real)	Domestic Demand Natural Gas (1000 cubic meters)	Domestic Demand plus Export Demand Natural Gas (1000 cubic meters)	Available "2P" Reserves (1000 cubic meters)	Amount Needed to Meet Domestic Volume of Gas Demand (1000 cubic meters)	Quantity of Required Gas Imports (1000 cubic meters)	Gas Imports expressed in real equivalence (Ton)	Value of Coal Imports (Net of Production Costs) (USD Real)
2012	300,00	8700,00	4000,00	62911,00	49911,00	2199650,00	943665,00	49911,00	62911,00	2706900,00	0,00	0,00	0.00	0.00
2013	145,00	7500,00	10000,00	63634,48	45989,48	3581935,00	954517,15	45989,48	63634,48	2643265,52	0,00	0,00	0.00	0.00
2014	145,00	7500,00	10000,00	64366,27	46721,27	3581935,00	965494,09	46449,37	64094,37	2578899,25	-271,90	-271,90	-115,18	-13595,09
2015	145,00	7500,00	10000,00	65106,49	47461,49	3581935,00	976597,28	46913,86	64558,86	2513792,77	-547,62	-547,62	-231,98	-27381,01
2016	145,00	7500,00	25000,00	65855,21	33210,21	6626935,00	987828,15	47383,00	80028,00	2447937,56	14172,79	14172,79	6003,87	708639,70
2017	145,00	7500,00	25000,00	67172,31	34527,31	6626935,00	1007584,71	47714,68	80359,68	2380765,24	13187,37	13187,37	5586,43	659368,54
2018	145,00	7500,00	25000,00	68515,76	35870,76	6626935,00	1027736,40	48048,69	80693,69	2312249,48	12177,93	12177,93	5158,81	608896,36
2019	145,00	7500,00	25000,00	69886,08	37241,08	6626935,00	1048291,13	48385,03	81030,03	2242363,41	11143,95	11143,95	4720,79	557197,64
2020	145,00	7500,00	25000,00	71283,80	38638,80	6626935,00	1069256,95	48723,72	81368,72	2171079,61	10084,93	10084,93	4272,17	504246,33
2021	145,00	7500,00	25000,00	72709,47	40064,47	6626935,00	1090642,09	49064,79	81709,79	2098370,14	9000,32	9000,32	3812,71	450015,84
2022	145,00	7500,00	25000,00	73232,98	40587,98	6626935,00	1098494,72	50046,09	82691,09	2025137,16	9458,10	9458,10	4006,64	472905,21
2023	145,00	7500,00	25000,00	73760,26	41115,26	6626935,00	1106403,88	51047,01	83692,01	1951376,90	9931,75	9931,75	4207,28	496587,43
2024	145,00	7500,00	25000,00	74291,33	41646,33	6626935,00	1114369,99	52067,95	84712,95	1877085,56	10421,61	10421,61	4414,80	521080,74
2025	145,00	7500,00	25000,00	74826,23	42181,23	6626935,00	1122393,45	53109,31	85754,31	1802259,33	10928,08	10928,08	4629,34	546403,81
2026	145,00	7500,00	25000,00	75364,98	42719,98	6626935,00	1130474,68	54171,49	86816,49	1726894,36	11451,51	11451,51	4851,08	572575,67
2027	145,00	7500,00	25000,00	75907,61	43262,61	6626935,00	1138614,10	55254,92	87899,92	1650986,75	11992,32	11992,32	5080,18	599615,77
2028	145,00	7500,00	25000,00	76454,14	43809,14	6626935,00	1146812,12	56360,02	89005,02	1574532,61	12550,88	12550,88	5316,79	627543,95
2029	145,00	7500,00	25000,00	77004,61	44359,61	6626935,00	1155069,17	57487,22	90132,22	1497528,00	13127,61	13127,61	5561,11	656380,48
2030	145,00	7500,00	25000,00	77559,04	44914,04	6626935,00	1163385,67	58636,97	91281,97	1419968,95	13722,92	13722,92	5813,29	686146,05
2031	145,00	7500,00	25000,00	78117,47	45472,47	6626935,00	1171762,04	59809,70	92454,70	1341851,48	14337,24	14337,24	6073,53	716861,75
2032	145,00	7500,00	25000,00	78679,92	46034,92	6626935,00	1180198,73	61005,90	93650,90	1263171,57	14970,98	14970,98	6342,00	748549,17
2033	145,00	7500,00	25000,00	79246,41	46601,41	6626935,00	1188696,16	62226,02	94871,02	1183925,16	15624,61	15624,61	6618,89	781230,30
2034	145,00	7500,00	25000,00	79816,98	47171,98	6626935,00	1197254,77	63470,54	96115,54	1104108,17	16298,55	16298,55	6904,38	814927,61
2035	145,00	7500,00	25000,00	80391,67	47746,67	6626935,00	1205875,01	64739,95	97384,95	1023716,50	16993,28	16993,28	7198,68	849664,03
2036	145,00	7500,00	25000,00	80970,49	48325,49	6626935,00	1214557,31	66034,75	98679,75	942746,02	17709,26	17709,26	7501,98	885462,98
2037	145,00	7500,00	25000,00	81553,47	48908,47	6626935,00	1223302,12	67355,44	100000,44	861192,54	18446,97	18446,97	7814,49	922348,35
2038	145,00	7500,00	25000,00	82140,66	49495,66	6626935,00	1232109,90	68702,55	101347,55	779051,88	19206,89	19206,89	8136,41	960344,54
2039	145,00	7500,00	25000,00	82732,07	50087,07	6626935,00	1240981,09	70076,60	102721,60	696319,81	19989,53	19989,53	8467,95	999476,45
2040	145,00	7500,00	25000,00	83327,74	50682,74	6626935,00	1249916,15	71478,13	104123,13	612992,07	20795,39	20795,39	8809,33	1039769,51
2041	145,00	7500,00	25000,00	83927,70	51282,70	6626935,00	1258915,55	72907,70	105552,70	529064,36	21624,99	21624,99	9160,77	1081249,65
2042	145,00	7500,00	25000,00	84531,98	51886,98	6626935,00	1267979,74	74365,85	107010,85	444532,38	22478,87	22478,87	9522,48	1123943,38
2043	145,00	7500,00	25000,00	85140,61	52495,61	6626935,00	1277109,19	75853,17	108498,17	359391,77	23357,55	23357,55	9894,71	1167877,71
2044	145,00	7500,00	25000,00	85753,63	53108,63	6626935,00	1286304,38	77370,23	110015,23	273638,14	24261,61	24261,61	10277,68	1213080,26
2045	145,00	7500,00	25000,00	86371,05	53726,05	6626935,00	1295565,77	78917,64	111562,64	187267,09	25191,58	25191,58	10671,64	1259579,19
2046	145,00	7500,00	25000,00	86992,92	54347,92	6626935,00	1304893,84	80495,99	113140,99	100274,17	26148,06	26148,06	11076,83	1307403,24
2047	0,00	0,00	0,00	87619,27	87619,27	0,00	1314289,08	82105,91	82105,91	12654,90	-18168,26	-18168,26	-7696,43	-908413,08
2048	0,00	0,00	0,00	12654,90	12654,90	0,00	189822,46	83748,03	83748,03	0,00	71093,13	71093,13	30116,42	3554656,43
2049	0,00	0,00	0,00	0,00	0,00	0,00	0,00	85422,99	85422,99	0,00	85422,99	85422,99	36186,83	4271149,31
2050	0,00	0,00	0,00	0,00	0,00	0,00	0,00	87131,45	87131,45	0,00	87131,45	87131,45	36910,56	4356572,30
2051	0,00	0,00	0,00	0,00	0,00	0,00	0,00	88874,07	88874,07	0,00	88874,07	88874,07	37648,78	4443703,74
2052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	90651,56	90651,56	0,00	90651,56	90651,56	38401,75	4532577,82
2053	0,00	0,00	0,00	0,00	0,00	0,00	0,00	92464,59	92464,59	0,00	92464,59	92464,59	39169,79	4623229,37
2054	0,00	0,00	0,00	0,00	0,00	0,00	0,00	94313,88	94313,88	0,00	94313,88	90492,57	38334,40	4524628,54
2055	0,00	0,00	0,00	0,00	0,00	0,00	0,00	96200,16	96200,16	0,00	96200,16	0,00	0.00	0.00
2056	0,00	0,00	0,00	0,00	0,00	0,00	0,00	98124,16	98124,16	0,00	98124,16	0,00	0.00	0.00
2057	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100086,64	100086,64	0,00	100086,64	0,00	0.00	0.00
2058	0,00	0,00	0,00	0,00	0,00	0,00	0,00	102088,38	102088,38	0,00	102088,38	0,00	0.00	0.00
2059	0,00	0,00	0,00	0,00	0,00	0,00	0,00	104130,14	104130,14	0,00	104130,14	0,00	0.00	0.00
2060	0,00	0,00	0,00	0,00	0,00	0,00	0,00	106212,75	106212,75	0,00	106212,75	0,00	0.00	0.00
2061	0,00	0,00	0,00	0,00	0,00	0,00	0,00	108337,00	108337,00	0,00	108337,00	0,00	0.00	0.00
2062	0,00	0,00	0,00	0,00	0,00	0,00	0,00	110503,74	110503,74	0,00	110503,74	0,00	0.00	0.00
2063	0,00	0,00	0,00	0,00	0,00	0,00	0,00	112713,82	112713,82	0,00	112713,82	0,00	0.00	0.00
2064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	114968,09	114968,09	0,00	114968,09	0,00	0.00	0.00
2065	0,00	0,00	0,00	0,00	0,00	0,00	0,00	117267,45	117267,45	0,00	117267,45	0,00	0.00	0.00
Total	5.230	263.700	809.000	2.769.811	1.691.881	218.380.440	41.547.165	3.956.920	5.034.850	51.337.291	2.252.384	1.077.930	456.632	53.896.500

Total Export obligations   1.077.930

Present Value of Royalty	10.597.434	USD in real terms
Present Value of Coal imports	4.912.177	USD in real terms
Present Value of Capital Contribution (Net of Production Costs)	57.553.073	USD in real terms

Appendix 4: (cont'd)

Scenario 2. Best-Best-Best

SENSITIVITY ANALYSIS

Real Discount rate WACC	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
4%	26.888.104,97	16.343.016,12	145.419.909,94	10.545.088,85
5%	22.176.015,45	13.197.980,48	120.418.451,23	8.978.034,97
6%	18.778.514,57	10.820.145,78	102.256.181,13	7.958.368,79
7%	16.253.895,86	9.001.258,03	88.646.703,18	7.252.637,83
8%	14.323.809,25	7.593.209,45	78.149.877,13	6.730.599,80
9%	12.809.449,34	6.489.906,25	69.840.433,09	6.319.543,09
10%	11.593.539,21	5.614.786,22	63.110.890,11	5.978.753,00
11%	10.597.433,88	4.912.177,25	57.553.072,93	5.685.256,63
12%	9.767.164,19	4.341.280,64	52.886.026,00	5.425.883,55
13%	9.064.817,98	3.871.957,56	48.911.573,91	5.192.860,42
14%	8.463.140,28	3.481.761,08	45.486.523,58	4.981.379,20
15%	7.942.096,99	3.153.832,94	42.504.996,53	4.788.264,05

Real Well-head Price of Gas (USD)	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
35	7.418.203,72	3.438.524,08	61.805.891,66	3.979.679,64
40	57.467.773,68	3.929.741,80	60.388.285,41	4.548.205,30
45	9.537.690,49	4.420.959,53	58.970.679,17	5.116.730,97
50	10.597.433,88	4.912.177,25	57.553.072,93	5.685.256,63
55	11.657.177,27	5.403.394,98	56.135.466,68	6.253.782,29
60	12.716.920,66	5.894.612,70	54.717.860,44	6.822.307,95
65	13.776.664,04	6.385.830,43	53.300.254,19	7.390.833,62
70	14.836.407,43	6.877.048,15	51.882.647,95	7.959.359,28
75	15.896.150,82	7.368.265,88	50.465.041,71	8.527.884,94

Percentage Change of Real Export Prices	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
-10%	10.597.433,88	4.912.177,25	45.623.372,63	5.685.256,63
-5%	10.597.433,88	4.912.177,25	51.456.058,45	5.685.256,63
-2%	10.597.433,88	4.912.177,25	55.082.547,70	5.685.256,63
-1%	10.597.433,88	4.912.177,25	56.312.523,74	5.685.256,63
0%	10.597.433,88	4.912.177,25	57.553.072,93	5.685.256,63
1%	10.597.433,88	4.912.177,25	58.804.195,26	5.685.256,63
2%	10.597.433,88	4.912.177,25	60.065.890,74	5.685.256,63
5%	10.597.433,88	4.912.177,25	63.914.416,05	5.685.256,63
10%	10.597.433,88	4.912.177,25	70.540.087,83	5.685.256,63

TABLE OF PARAMETERS

Prices, as of 2012

Well Head Price of gas	50,00	USD / 1000 m3
Well head price of natural gas in Coal equivalence	118,03	USD / Ton of coal (including transportation cost)
Percentage Change of Real Export Prices	0%	*Base case scenario

Royalty Rate

	30%	"Uztransgas" JS Company
WACC	15%	*estimated (not constant over time)

Kwh generated per unit of fuel used	1870	kWh per Ton of Coal
	125	kwh per 1000 cubic feet of natural gas

Conversion Factor	0,423619328	Ton of Coal per 1000 cm of Natural Gas

Production Costs

Production Cost	35,00	($/1000m3)
Production cost in coal equivalence / ton	82,6	($/Ton of coal)
Worth of 1 Ton coal in terms of Well Head Price net of Production costs of Natural Gas	35,4	($/Ton of coal)

	Bmc	Probability	Recoverable Reserves (bmc)
Total Proven Reserves	1.841,00	90%	1.656,90
Probable Natural Gas Resources	2.100,00	50%	1.050,00
Possible Natural Gas Resources	5.900,00	10%	590,00

Conversions

1 bmc (billion cubic metres)	1.000.000.000	mc (cubic metre)
1000 m3 or thousand mc	1.000	cubic metres
1 cubic foot	0,0283168	cubic metres
1 Tcf (Trillion cubic feet)	28,3	bmc

UZBEKISTAN NATURAL GAS DEMAND/SUPPLY MODULE

	Data as of Year 2012			
	Russia	Tajikistan	Kyrgyzistan	China
Export Price ($/1000m3)	253	300	290	140
Export Volume (bcm)	8,7	0,155	0,145	4
Total Revenue USD	2.201.100.000	46.500.000	42.050.000	560.000.000
Contribution of Export Price to Capital Recovery (per 1000m3) As of 2012	203,00	250,00	240,00	90,00
Total Value of Contribution USD	1.766.100	38.750	34.800	360.000

	Data as of Year 2013			
	Russia	Tajikistan	Kyrgyzistan	China
Export Price ($/1000m3)	253	300	253	253
Export Volume (bcm)	7,5	0	0,145	10
Total Revenue USD	################	0	36.685.000	2.530.000.000
Contribution of Export Price to Capital Recovery (per 1000m3) As of 2012	203,00	250,00	203,00	203,00
Total Value of Contribution USD	1.522.500	0	29.435	2.030.000

*Demand/Supply assumptions table

	Russia	Tajikistan	Kyrgyzistan	China	Domestic Demand	Export Capacity	Supply (Production)
Total Volume (1000 m3 as of 2012)	8.700	155	145	4.000	49.911	13.000	62.911
Total Volume (1000 m3 as of 2013)	7.500	0,00	145	10.000	45.989	17.645	63.634
Short term annual growth rate (2012-2016)	0%	0%	0%	0%	1,00%	1,72%	1,15%
Medium term annual growth rate (2016-2021)	0%	0%	0%	25.000	0,70%	7,76%	2,0%
Longer term annual growth rate (up to 2050)	0%	0%	0%	25.000	3%	#NUM!	-1%

Scenario 2a. High-Low-Best

Cost-Benefit Analysis of Natural Gas Exports

Year	Quantity of Gas Supplied to Tajikistan and Kyrgyzstan (1000 m³)	Quantity of Gas Supplied to Russia (1000 m³)	Quantity of Gas Supplied to China (1000 m³)	Supply (Total Volume of Gas Production) (1000 m³)	Quantity of Gas Supplied to Domestic Market (1000 m³)	Value of Exports Net of Wellhead Price and transport cost (USD Real)	Royalty Payment (USD Real)	Domestic Demand Natural Gas (1000 m³)	Domestic Demand plus Export Demand Natural Gas (1000 m³)	Available "2P" Reserves (1000 m³)	Amount Needed to Meet Domestic Volume of Gas Demand (1000 m³)	Quantity of Required Gas Imports (1000 m³)	Gas Imports expressed in real equivalence (Ton)	Value of Coal Imports (Net of Production Costs) (USD Real)
2012	300.00	8700.00	4000.00	62911.00	49911.00	2199650.00	943665.00	49911.00	62911.00	2706900.00	0.00	0.00	0.00	0.00
2013	145.00	7500.00	10000.00	63634.48	45989.48	35819350.00	954517.15	45989.48	63634.48	2643265.52	0.00	0.00	0.00	0.00
2014	145.00	7500.00	10000.00	64366.27	46721.27	35819350.00	965494.09	46449.37	64094.37	2578899.25	-271.90	-271.90	-115.18	-13595.09
2015	145.00	7500.00	10000.00	65106.49	47461.49	35819350.00	976597.28	46913.86	64558.86	2513792.77	-547.62	-547.62	-231.98	-27381.01
2016	145.00	7500.00	25000.00	65855.21	33210.21	66269350.00	987828.15	47383.00	80028.00	2447937.56	14172.79	14172.79	6003.87	708639.70
2017	145.00	7500.00	25000.00	67172.31	34527.31	66269350.00	1007584.71	47714.68	80359.68	2380765.24	13187.37	13187.37	5586.43	659368.54
2018	145.00	7500.00	25000.00	68515.76	35870.76	66269350.00	1027736.40	48048.69	80693.69	2312249.48	12177.93	12177.93	5158.81	608896.36
2019	145.00	7500.00	25000.00	69886.08	37241.08	66269350.00	1048291.13	48385.03	81030.03	2242363.41	11143.95	11143.95	4720.79	557197.64
2020	145.00	7500.00	25000.00	71283.80	38638.80	66269350.00	1069256.95	48723.72	81368.72	2171079.61	10084.93	10084.93	4272.17	504246.33
2021	145.00	7500.00	25000.00	72709.47	40064.47	66269350.00	1090642.09	49064.79	81709.79	2098870.14	9000.32	9000.32	3812.71	450015.84
2022	145.00	7500.00	25000.00	71975.11	39330.11	66269350.00	1079626.61	50492.57	83137.57	2026395.03	11162.47	11162.47	4728.64	558123.39
2023	145.00	7500.00	25000.00	71248.16	38603.16	66269350.00	1068772.38	51961.91	84606.91	1955146.87	13358.75	13358.75	5659.02	667937.51
2024	145.00	7500.00	25000.00	70528.55	37883.55	66269350.00	1057928.28	53474.00	86119.00	1884618.32	15590.45	15590.45	6604.42	779522.41
2025	145.00	7500.00	25000.00	69816.21	37171.21	66269350.00	1047243.21	55030.09	87675.09	1814802.10	17858.88	17858.88	7565.37	892944.00
2026	145.00	7500.00	25000.00	69111.07	36466.07	66269350.00	1036666.05	56631.47	89276.47	1745691.03	20165.40	20165.40	8542.45	1008269.97
2027	145.00	7500.00	25000.00	68413.05	35768.05	66269350.00	1026195.72	58279.45	90924.45	1677277.99	22511.40	22511.40	9536.26	1125569.85
2028	145.00	7500.00	25000.00	67722.08	35077.08	66269350.00	1015831.15	59975.38	92620.38	1609555.91	24898.30	24898.30	10547.40	1244915.04
2029	145.00	7500.00	25000.00	67038.08	34393.08	66269350.00	1005571.25	61720.66	94365.66	1542517.83	27327.58	27327.58	11576.49	1366378.86
2030	145.00	7500.00	25000.00	66361.00	33716.00	66269350.00	995414.98	63516.73	96161.73	1476156.83	29800.73	29800.73	12624.17	1490036.65
2031	145.00	7500.00	25000.00	65690.75	33045.75	66269350.00	985361.29	65365.07	98010.07	1410466.08	32319.32	32319.32	13691.09	1615965.80
2032	145.00	7500.00	25000.00	65027.28	32382.28	66269350.00	975409.14	67267.19	99912.19	1345438.80	34884.92	34884.92	14777.92	1744245.81
2033	145.00	7500.00	25000.00	64370.36	31725.36	66269350.00	965557.51	69224.67	101869.67	1281068.30	37499.17	37499.17	15885.37	1874958.34
2034	145.00	7500.00	25000.00	63720.36	31075.36	66269350.00	955805.38	71239.11	103884.11	1217347.94	40163.75	40163.75	17014.14	2008187.34
2035	145.00	7500.00	25000.00	63076.78	30431.78	66269350.00	946151.74	73312.16	105957.16	1154271.16	42880.38	42880.38	18164.96	2144019.02
2036	145.00	7500.00	25000.00	62439.71	29794.71	66269350.00	936595.61	75445.55	108090.55	1091831.45	45650.84	45650.84	19338.58	2282541.99
2037	145.00	7500.00	25000.00	61809.07	29164.07	66269350.00	927136.00	77641.01	110286.01	1030022.38	48476.95	48476.95	20535.77	2428847.31
2038	145.00	7500.00	25000.00	61184.79	28539.79	66269350.00	917771.92	79900.37	112545.37	968837.59	51360.57	51360.57	21757.33	2568028.57
2039	145.00	7500.00	25000.00	60566.83	27921.83	66269350.00	908502.43	82225.47	114870.47	908270.76	54303.64	54303.64	23004.07	2715181.92
2040	145.00	7500.00	25000.00	59955.10	27310.10	66269350.00	899326.55	84618.23	117263.23	848315.66	57308.12	57308.12	24276.83	2865406.22
2041	145.00	7500.00	25000.00	59349.56	26704.56	66269350.00	890243.35	87080.62	119725.62	788966.10	60376.06	60376.06	25576.47	3018803.07
2042	145.00	7500.00	25000.00	58750.13	26105.13	66269350.00	881251.90	89614.66	122259.66	730215.97	63509.54	63509.54	26903.87	3175476.90
2043	145.00	7500.00	25000.00	58156.75	25511.75	66269350.00	872351.25	92222.45	124867.45	672059.22	66710.70	66710.70	28259.94	3335535.05
2044	145.00	7500.00	25000.00	57569.37	24924.37	66269350.00	863540.50	94906.12	127551.12	614489.86	69981.76	69981.76	29645.63	3499087.87
2045	145.00	7500.00	25000.00	56987.92	24342.92	66269350.00	854818.74	97667.89	130312.89	557501.94	73324.98	73324.98	31061.88	3666248.81
2046	145.00	7500.00	25000.00	56412.34	23767.34	66269350.00	846185.08	100510.03	133155.03	501089.60	76742.69	76742.69	32509.69	3837134.50
2047	145.00	7500.00	25000.00	55842.57	23197.57	66269350.00	837638.61	103434.87	136079.87	445247.03	80237.30	80237.30	33990.07	4011864.82
2048	145.00	7500.00	25000.00	55278.56	22633.56	66269350.00	829178.46	106444.82	139089.82	389968.46	83811.26	83811.26	35504.07	4190563.05
2049	145.00	7500.00	25000.00	54720.25	22075.25	66269350.00	820803.75	109542.37	142187.37	335248.21	87467.12	67926.35	28774.92	3396317.61
2050	145.00	7500.00	25000.00	54167.58	21522.58	66269350.00	812513.64	112730.05	145375.05	281080.64	91207.48	0.00	0.00	0.00
2051	145.00	7500.00	25000.00	53620.48	20975.48	66269350.00	804307.25	116010.50	148655.50	227460.15	95035.01	0.00	0.00	0.00
2052	145.00	7500.00	25000.00	53078.92	20433.92	66269350.00	796183.74	119386.40	152031.40	174381.24	98952.49	0.00	0.00	0.00
2053	145.00	7500.00	25000.00	52542.82	19897.82	66269350.00	788142.29	122860.55	155505.55	121838.42	102962.73	-18875.69	0.00	0.00
2054	145.00	7500.00	25000.00	52012.14	19367.14	66269350.00	780182.05	126435.79	159080.79	69826.28	107068.65	37242.37	0.00	0.00
2055	0.00	0.00	0.00	51486.81	51486.81	0.00	772302.21	130115.07	130115.07	18339.47	78628.26	60288.79	0.00	0.00
2056	0.00	0.00	0.00	18339.47	18339.47	0.00	275092.02	133901.42	133901.42	0.00	115561.95	0.00	0.00	0.00
2057	0.00	0.00	0.00	0.00	0.00	0.00	0.00	137797.95	137797.95	0.00	137797.95	0.00	0.00	0.00
2058	0.00	0.00	0.00	0.00	0.00	0.00	0.00	141807.87	141807.87	0.00	141807.87	0.00	0.00	0.00
2059	0.00	0.00	0.00	0.00	0.00	0.00	0.00	145934.48	145934.48	0.00	145934.48	0.00	0.00	0.00
2060	0.00	0.00	0.00	0.00	0.00	0.00	0.00	150181.17	150181.17	0.00	150181.17	0.00	0.00	0.00
2061	0.00	0.00	0.00	0.00	0.00	0.00	0.00	154551.44	154551.44	0.00	154551.44	0.00	0.00	0.00
2062	0.00	0.00	0.00	0.00	0.00	0.00	0.00	159048.89	159048.89	0.00	159048.89	0.00	0.00	0.00
2063	0.00	0.00	0.00	0.00	0.00	0.00	0.00	163677.21	163677.21	0.00	163677.21	0.00	0.00	0.00
2064	0.00	0.00	0.00	0.00	0.00	0.00	0.00	168440.22	168440.22	0.00	168440.22	0.00	0.00	0.00
2065	0.00	0.00	0.00	0.00	0.00	0.00	0.00	173341.83	173341.83	0.00	173341.83	0.00	0.00	0.00
Total	6.390	323.700	1.009.000	2.769.811	1.430.721	271.395.920	41.547.165	4.873.549	6.212.639	57.011.368	3.223.824	1.339.090	567.264	66.954.500

Total Export obligations 1.339.090

Present Value of Royalty   7,697.657 USD in real terms
Present Value of Coal imports (Net of Production Costs)   4,454.755 USD in real terms
Present Value of Capital Contribution   42,832.469 USD in real terms

Appendix 5: (cont'd)

Scenario 2a. High-Low-Best

SENSITIVITY ANALYSIS

Real Discount rate WACC	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
4%	25.863.488,90	26.366.462,82	164.281.162,06	- 502.973,91
5%	21.210.928,02	21.410.346,84	132.972.898,69	- 199.418,82
6%	17.899.925,91	17.559.595,54	110.688.550,01	340.330,37
7%	15.471.037,47	14.544.059,91	94.359.268,72	926.977,57
8%	13.635.940,43	12.163.811,45	82.051.485,31	1.472.128,97
9%	12.210.582,61	10.270.013,54	72.525.708,93	1.940.569,07
10%	11.075.266,30	8.751.206,31	64.972.433,06	2.324.059,99
11%	10.150.571,91	7.523.422,61	58.852.372,13	2.627.149,30
12%	9.382.675,51	6.523.028,11	53.798.707,63	2.859.647,40
13%	8.734.288,34	5.701.508,44	49.556.538,61	3.032.779,90
14%	8.178.993,52	5.021.654,27	45.944.879,44	3.157.339,25
15%	7.697.656,83	4.454.755,31	42.832.469,27	3.242.901,52

Real Well-head Price of Gas (USD)	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
35	7.105.400,34	5.266.395,83	63.201.198,19	1.839.004,51
40	8.120.457,53	6.018.738,09	61.751.589,51	2.101.719,44
45	9.135.514,72	6.771.080,35	60.301.980,82	2.364.434,37
50	10.150.571,91	7.523.422,61	58.852.372,13	2.627.149,30
55	11.165.629,10	8.275.764,87	57.402.763,44	2.889.864,23
60	12.180.686,29	9.028.107,13	55.953.154,76	3.152.579,16
65	13.195.743,48	9.780.449,39	54.503.546,07	3.415.294,09
70	14.210.800,67	10.532.791,65	53.053.937,38	3.678.009,02
75	15.225.857,86	11.285.133,91	51.604.328,69	3.940.723,95

Percentage Change of Real Export Prices	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
-10%	10.150.571,91	7.523.422,61	46.648.483,06	2.627.149,30
-5%	10.150.571,91	7.523.422,61	52.615.145,04	2.627.149,30
-2%	10.150.571,91	7.523.422,61	56.325.013,48	2.627.149,30
-1%	10.150.571,91	7.523.422,61	57.583.281,50	2.627.149,30
0%	10.150.571,91	7.523.422,61	58.852.372,13	2.627.149,30
1%	10.150.571,91	7.523.422,61	60.132.285,36	2.627.149,30
2%	10.150.571,91	7.523.422,61	61.423.021,20	2.627.149,30
5%	10.150.571,91	7.523.422,61	65.360.164,34	2.627.149,30
10%	10.150.571,91	7.523.422,61	72.138.521,67	2.627.149,30

APPENDIX 6
Scenario 2b. Low-High-Best

TABLE OF PARAMETERS

Prices, as of 2012

Well Head Price of gas	50,00	USD / 1000 m3
Well head price of natural gas in Coal equivalence	118,03	USD / Ton of coal (including transportation cost)
Percentage Change of Real Export Prices	0%	*Base case scenario

Royalty Rate

	30%	"Uztransgas" JS Company
WACC	11%	*estimated (not constant over time)

Kwh generated per unit of fuel used	1870	kWh per Ton of Coal
	125	kwh per 1000 cubic feet of natural gas

Conversion		
Factor	0,42361928	Ton of Coal per 1000 cm of Natural Gas
Production Costs		
Production Cost	35,00	($/1000m3)
Production cost in coal equivalence / ton	82,6	($/Ton of coal)
Worth of 1 Ton coal in terms of Well Head Price net of	35,4	($/Ton of coal)
Production costs of Natural Gas		

	Bmc	Probability	Recoverable Reserves (bmc)
Total Proven Reserves	1.841,00	90%	1.656,90
Probable Natural Gas Resources	2.100,00	50%	1.050,00
Possible Natural Gas Resources	5.900,00	10%	590,00

Conversions

1 bmc (billion cubic metres)	1.000.000.000 mc (cubic metre)	
1000 m3 or thousand mc	1.000 cubic metres	
1 cubic foot	0,0283168 cubic metres	
1 Tcf (Trillion cubic feet)	28,3 bmc	

UZBEKISTAN NATURAL GAS DEMAND/SUPPLY MODULE

	Data as of Year 2012					Data as of Year 2013			
	Russia	Tajikistan	Kyrgyzistan	China		Russia	Tajikistan	Kyrgyzistan	China
Export Price ($/1000m3)	253	253	300	290	140	253	253	300	253
Export Volume (bcm)	8,7	0,155	0,145	4		7,5	0,145	0	10
Total Revenue USD	#############	46.500.000	42.050.000	560.000.000		#############	36.685.000	0	2.530.000.000
Contribution of Export Price to Capital Recovery (per 1000m3) As of **2012**	203,00	250,00	240,00	90,00		203,00	250,00	203,00	203,00
Total Value of Contribution USD	1.766.100	38.750	34.800	360.000		1.522.500	0	29.435	2.030.000

*Demand/Supply assumptions table	Russia	Tajikistan	Kyrgyzistan	China	Supply (Production)	Domestic Demand	Export Capacity
Total Volume (1000 m3 as of 2012)	8.700	155	145	4.000	62.911	49.911	13.000
Total Volume (1000 m3 as of 2013)	7.500	0,00	145	10.000	63.634	45.989	17.645
Short term annual growth rate (2012-2016)	0%	0%	0%	0%	1,15%	1,00%	1,72%
Medium term annual growth rate (2016-2021)	0%	0%	0%	25.000	2,0%	0,70%	7,76%
Longer term annual growth rate (up to 2050)	0%	0%	0%	0%	0,9%	-1%	14,52%

APPENDIX 6: (cont'd)
Scenario 2b. Low-High-Best

Cost-Benefit Analysis of Natural Gas Exports

Year	Quantity of Gas Supplied to Tajikistan and Kyrgyzstan (1000 cubic meters)	Quantity of Gas Supplied to Russia (1000 cubic meters)	Quantity of Gas Supplied to China (1000 cubic meters)	Supply (Total Volume of Gas Production) (1000 cubic meters)	Quantity of Gas Supplied to Domestic Market (1000 cubic meters)	Value of Exports Net of Wellhead Price and transport cost (USD Real)	Royalty Payment (USD Real)	Domestic Demand Natural Gas (1000 cubic meters)	Domestic Demand plus Export Demand Natural Gas (1000 cubic meters)	Available "2P" Reserves (1000 cubic meters)	Amount Needed to Meet Domestic Volume of Gas Demand (1000 cubic meters)	Quantity of Required Gas Imports (1000 cubic meters)	Gas Imports expressed in coal equivalence (Ton)	Value of Coal Imports (Net of Production Costs) (USD Real)
2012	300,00	8700,00	4000,00	62911,00	49911,00	2199650,00	943665,00	49911,00	62911,00	2706900,00	0,00	0,00	0,00	0,00
2013	145,00	7500,00	10000,00	63634,48	45989,48	3581935,00	954517,15	45989,48	63634,48	2643265,52	0,00	0,00	0,00	0,00
2014	145,00	7500,00	10000,00	64366,27	46721,27	3581935,00	965494,09	46449,37	64094,37	2578899,25	-271,90	-271,90	-115,18	-13595,09
2015	145,00	7500,00	10000,00	65106,49	47461,49	3581935,00	976597,28	46913,86	64558,86	2513792,77	-547,62	-547,62	-231,98	-27381,01
2016	145,00	7500,00	25000,00	65855,21	33210,21	6626935,00	987828,15	47383,00	80028,00	2447937,56	14172,79	14172,79	6003,87	708639,70
2017	145,00	7500,00	25000,00	67172,31	34527,31	6626935,00	1007584,71	47714,68	80359,68	2380765,24	13187,37	13187,37	5586,43	659368,54
2018	145,00	7500,00	25000,00	68515,76	35870,76	6626935,00	1027736,40	48048,69	80693,69	2312249,48	12177,93	12177,93	5158,81	608896,36
2019	145,00	7500,00	25000,00	69886,08	37241,08	6626935,00	1048291,13	48385,03	81030,03	2244363,41	11143,95	11143,95	4720,79	557197,64
2020	145,00	7500,00	25000,00	71283,80	38638,80	6626935,00	1069256,95	48723,72	81368,72	2171079,61	10084,93	10084,93	4272,17	504246,33
2021	145,00	7500,00	25000,00	72709,47	40064,47	6626935,00	1090642,09	49064,79	81709,79	2098370,14	9000,32	9000,32	3812,71	450015,84
2022	145,00	7500,00	25000,00	73356,59	40711,59	6626935,00	1100348,81	49422,04	82067,04	2025013,55	7710,45	7710,45	3266,30	385522,68
2023	145,00	7500,00	25000,00	74009,46	41364,46	6626935,00	1110141,91	47787,71	80432,71	1951004,09	6423,25	6423,25	2721,01	321162,56
2024	145,00	7500,00	25000,00	74668,14	42023,14	6626935,00	1120022,17	47161,69	79806,69	1876335,94	5138,55	5138,55	2176,79	256927,40
2025	145,00	7500,00	25000,00	75332,69	42687,69	6626935,00	1129990,37	46543,87	79188,87	1801003,25	3856,18	3856,18	1633,55	192809,17
2026	145,00	7500,00	25000,00	76003,15	43358,15	6626935,00	1140047,29	45934,15	78579,15	1725000,10	2576,00	2576,00	1091,24	128799,88
2027	145,00	7500,00	25000,00	76679,38	44034,58	6626935,00	1150193,71	45332,41	77977,41	1648320,52	1297,83	1297,83	549,79	64891,61
2028	145,00	7500,00	25000,00	77362,03	44717,03	6626935,00	1160430,43	44738,56	77383,56	1570958,49	21,53	21,53	9,12	1076,47
2029	145,00	7500,00	25000,00	78050,55	45405,55	6626935,00	1170758,26	44152,48	76797,48	1492907,94	-1253,07	-1253,07	-530,82	-62653,39
2030	145,00	7500,00	25000,00	78745,20	46100,20	6626935,00	1181178,01	43574,09	76219,09	1414162,74	-2526,12	-2526,12	-1070,11	-126305,76
2031	145,00	7500,00	25000,00	79446,03	46801,03	6626935,00	1191690,49	43003,26	75648,26	1334716,71	-3797,77	-3797,77	-1608,81	-189888,40
2032	145,00	7500,00	25000,00	80153,10	47508,10	6626935,00	1202296,54	42439,92	75084,92	1254563,60	-5068,18	-5068,18	-2146,98	-253409,02
2033	145,00	7500,00	25000,00	80866,47	48221,47	6626935,00	1212996,98	41883,96	74528,96	1173697,14	-6337,51	-6337,51	-2684,69	-316875,30
2034	145,00	7500,00	25000,00	81586,18	48941,18	6626935,00	1223792,65	41335,28	73980,28	1092110,96	-7605,90	-7605,90	-3222,01	-380294,87
2035	145,00	7500,00	25000,00	82312,29	49667,29	6626935,00	1234684,41	40793,79	73438,79	1009798,67	-8873,51	-8873,51	-3758,99	-443675,33
2036	145,00	7500,00	25000,00	83044,87	50399,87	6626935,00	1245673,10	40259,39	72904,39	926753,79	-10140,48	-10140,48	-4295,71	-507024,23
2037	145,00	7500,00	25000,00	83783,97	51138,97	6626935,00	1256759,59	39731,99	72376,99	842969,82	-11406,98	-11406,98	-4832,21	-570349,10
2038	145,00	7500,00	25000,00	84529,65	51884,65	6626935,00	1267944,75	39211,50	71856,50	758440,17	-12673,15	-12673,15	-5368,59	-633657,42
2039	145,00	7500,00	25000,00	85281,96	52636,96	6626935,00	1279229,46	38697,83	71342,83	673158,21	-13939,13	-13939,13	-5904,89	-696956,65
2040	145,00	7500,00	25000,00	86040,97	53395,97	6626935,00	1290614,60	38190,89	70835,89	588717,24	-15205,08	-15205,08	-6441,17	-760254,20
2041	145,00	7500,00	25000,00	86806,74	54161,74	6626935,00	1302101,07	37690,59	70335,59	500310,50	-16471,15	-16471,15	-6977,50	-823557,47
2042	145,00	7500,00	25000,00	87579,32	54934,32	6626935,00	1313689,77	37196,84	69841,84	412731,18	-17737,48	-17737,48	-7513,94	-886873,80
2043	145,00	7500,00	25000,00	88358,77	55713,77	6626935,00	1325381,61	36709,56	69354,56	324372,41	-19004,21	-19004,21	-8050,55	-950210,53
2044	145,00	7500,00	25000,00	89145,17	56500,17	6626935,00	1337177,50	36228,67	68873,67	235227,24	-20271,50	-20271,50	-8587,40	-1013574,95
2045	145,00	7500,00	25000,00	89938,56	57293,56	6626935,00	1349078,38	35754,07	68399,07	145288,68	-21539,49	-21539,49	-9124,54	-1076974,32
2046	145,00	7500,00	25000,00	90739,01	58094,01	6626935,00	1361085,18	35285,69	67930,69	54549,67	-22808,32	-22808,32	-9662,04	-1140415,90
2047	0,00	0,00	0,00	54549,67	54549,67	0,00	818245,01	34823,45	34823,45	0,00	-19726,22	-19726,22	-8356,41	-986310,79
2048	0,00	0,00	0,00	0,00	0,00	0,00	0,00	34367,26	34367,26	0,00	34367,26	34367,26	14558,64	1718363,21
2049	0,00	0,00	0,00	0,00	0,00	0,00	0,00	33917,05	33917,05	0,00	33917,05	33917,05	14367,92	1695852,66
2050	0,00	0,00	0,00	0,00	0,00	0,00	0,00	33472,74	33472,74	0,00	33472,74	33472,74	14179,70	1673636,99
2051	0,00	0,00	0,00	0,00	0,00	0,00	0,00	33034,25	33034,25	0,00	33034,25	33034,25	13993,95	1651712,34
2052	0,00	0,00	0,00	0,00	0,00	0,00	0,00	32601,50	32601,50	0,00	32601,50	32601,50	13810,62	1630074,91
2053	0,00	0,00	0,00	0,00	0,00	0,00	0,00	32174,42	32174,42	0,00	32174,42	32174,42	13629,71	1608720,93
2054	0,00	0,00	0,00	0,00	0,00	0,00	0,00	31752,93	31752,93	0,00	31752,93	31752,93	13451,16	1587646,68
2055	0,00	0,00	0,00	0,00	0,00	0,00	0,00	31336,97	31336,97	0,00	31336,97	31336,97	13274,95	1566848,51
2056	0,00	0,00	0,00	0,00	0,00	0,00	0,00	30926,46	30926,46	0,00	30926,46	30926,46	13101,04	1546322,80
2057	0,00	0,00	0,00	0,00	0,00	0,00	0,00	30521,32	30521,32	0,00	30521,32	30521,32	12929,42	1526065,97
2058	0,00	0,00	0,00	0,00	0,00	0,00	0,00	30121,49	30121,49	0,00	30121,49	30121,49	12760,05	1506074,50
2059	0,00	0,00	0,00	0,00	0,00	0,00	0,00	29726,90	29726,90	0,00	29726,90	29726,90	12592,89	1486344,93
2060	0,00	0,00	0,00	0,00	0,00	0,00	0,00	29337,48	29337,48	0,00	29337,48	29337,48	12427,92	1466873,81
2061	0,00	0,00	0,00	0,00	0,00	0,00	0,00	28953,16	28953,16	0,00	28953,16	28953,16	12265,12	1447657,76
2062	0,00	0,00	0,00	0,00	0,00	0,00	0,00	28573,87	28573,87	0,00	28573,87	28573,87	12104,44	1428693,45
2063	0,00	0,00	0,00	0,00	0,00	0,00	0,00	28199,55	28199,55	0,00	28199,55	28199,55	11945,87	1409977,56
2064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	27830,14	27830,14	0,00	27830,14	27830,14	11789,38	1391506,86
2065	0,00	0,00	0,00	0,00	0,00	0,00	0,00	27465,56	27465,56	0,00	27465,56	27465,56	11634,94	1373278,12
Total	5.230	263.700	809.000	2.769.811	1.691.881	218.380.440	41.547.165	2.105.780	3.183.710	50.926.136	413.899	413.899	175.336	20.694.969

Total Export obligations 1,077,930

Present Value of Royalty 10.638.688 USD in real terms
Present Value of Coal imports (Net of Production Costs) 1.916.665 USD in real terms
Present Value of Capital Contribution 57.553.073 USD in real terms

Appendix 6: (cont'd)

Scenario 2b. Low-High-Best

SENSITIVITY ANALYSIS

Real Discount rate WACC	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
4%	26.970.947,95	1.640.682,95	145.419.909,94	25.330.265,00
5%	22.255.894,18	1.749.087,35	120.418.451,23	20.506.806,82
6%	18.852.841,74	1.833.667,36	102.256.181,13	17.019.174,38
7%	16.321.485,94	1.892.584,33	88.646.703,18	14.428.901,61
8%	14.384.329,19	1.927.233,08	78.149.877,13	12.457.096,11
9%	12.863.064,67	1.940.515,45	69.840.433,09	10.922.549,22
10%	11.640.688,55	1.935.855,74	63.110.890,11	9.704.832,81
11%	10.638.687,60	1.916.664,81	57.553.072,93	8.722.022,79
12%	9.803.137,80	1.886.071,01	52.886.026,00	7.917.066,79
13%	9.096.120,93	1.846.806,39	48.911.573,91	7.249.314,54
14%	8.490.347,40	1.801.179,80	45.486.523,58	6.689.167,60
15%	7.965.734,21	1.751.096,16	42.504.996,53	6.214.638,05

Real Well-head Price of Gas (USD)	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
35	7.447.081,32	1.341.665,37	61.805.891,66	6.105.415,95
40	8.510.950,08	1.533.331,85	60.388.285,41	6.977.618,23
45	9.574.818,84	1.724.998,33	58.970.679,17	7.849.820,51
50	10.638.687,60	1.916.664,81	57.553.072,93	8.722.022,79
55	11.702.556,36	2.108.331,29	56.135.466,68	9.594.225,07
60	12.766.425,12	2.299.997,77	54.717.860,44	10.466.427,35
65	13.830.293,88	2.491.664,25	53.300.254,19	11.338.629,63
70	14.894.162,64	2.683.330,73	51.882.647,95	12.210.831,91
75	15.958.031,40	2.874.997,21	50.465.041,71	13.083.034,19

Percentage Change of Real Export Prices	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
-10%	10.638.687,60	1.916.664,81	45.623.372,63	8.722.022,79
-5%	10.638.687,60	1.916.664,81	51.456.058,45	8.722.022,79
-2%	10.638.687,60	1.916.664,81	55.082.547,70	8.722.022,79
-1%	10.638.687,60	1.916.664,81	56.312.523,74	8.722.022,79
0%	10.638.687,60	1.916.664,81	57.553.072,93	8.722.022,79
1%	10.638.687,60	1.916.664,81	58.804.195,26	8.722.022,79
2%	10.638.687,60	1.916.664,81	60.065.890,74	8.722.022,79
5%	10.638.687,60	1.916.664,81	63.914.416,05	8.722.022,79
10%	10.638.687,60	1.916.664,81	70.540.087,83	8.722.022,79

TABLE OF PARAMETERS

Prices, as of 2012

Well Head Price of gas	50,00	USD / 1000 m3
Well head price of natural gas in Coal equivalence	118,03	USD / Ton of coal (including transportation cost)
Percentage Change of Real Export Prices	10%	*Base case scenario

Royalty Rate — 30% "Uztransgas" JS Company
WACC — 11% *estimated (not constant over time)

Kwh generated per unit of fuel used	1870	kWh per Ton of Coal
	125	kwh per 1000 cubic feet of natural gas

Conversion Factor	0,423619328	Ton of Coal per 1000 cm of Natural Gas

Production Costs

Production Cost	35,00	($/1000m3)
Production cost in coal equivalence / ton	82,6	($/Ton of coal)
Worth of 1 Ton coal in terms of Well Head Price net of Production costs of Natural Gas	35,4	($/Ton of coal)

	Bmc	Probability	Recoverable Reserves (bmc)
Total Proven Reserves	1.841,00	90%	1.656,90
Probable Natural Gas Resources	2.100,00	50%	1.050,00
Possible Natural Gas Resources	5.900,00	10%	590,00

Conversions

1 bmc (billion cubic metres)	1.000.000.000	mc (cubic metre)
1000 m3 or thousand mc	1.000	cubic metres
1 cubic foot	0,0283168	cubic metres
1 Tcf (Trillion cubic feet)	28,3	bmc

UZBEKISTAN NATURAL GAS DEMAND/SUPPLY MODULE

	Data as of Year 2012			
	Russia	Tajikistan	Kyrgyzstan	China
Export Price ($/1000m3)	253	300	290	140
Export Volume (bcm)	8,7	0,155	0,145	4
Total RevenueUSD	2.201.100.000	46.500.000	42.050.000	560.000.000
Contribution of Export Price to Capital Recovery (per 1000m3) As of 2012	203,00	250,00	240,00	90,00
Total Value of Contribution USD	1.766.100	38.750	34.800	360.000

	Data as of Year 2013			
	Russia	Tajikistan	Kyrgyzstan	China
Export Price ($/1000m3)	278,3	330	306,13	306,13
Export Volume (bcm)	7,5	0	0,145	10
Total RevenueUSD	2.087.250.000	44.388.850	################	################
Contribution of Export Price to Capital Recovery (per 1000m3) As of 2012	228,30	280,00	256,13	256,13
Total Value of Contribution USD	1.712.250	37.139	0	2.561.300

*Demand/Supply assumptions table	Russia	Tajikistan	Kyrgyzstan	China	Supply (Production)	Domestic Demand	Export Capacity
Total Volume (1000 m3 as of 2012)	8.700	155	145	4.000	62.911	49.911	13.000
Total Volume (1000 m3 as of 2013)	7.500	0,00	145	10.000	63.634	45.989	17.645
Short term annual growth rate (2012-2016)	0%	0%	0%	0%	1.15%	1,00%	1,72%
Medium term annual growth rate (2016-2021)	0%	0%	0%	0%	2,0%	0,70%	7,76%
Longer term annual growth rate (up to 2050)	0%	0%	0%	0%	0,72%	2%	1,42%

APPENDIX 7: (cont'd)
Scenario 3. Best-Best-High

Cost-Benefit Analysis of Natural Gas Exports

Year	Quantity of Gas Supplied to Tajikistan and Kyrgyzstan (1000 cubic meters)	Quantity of Gas Supplied to Russia (1000 cubic meters)	Quantity of Gas Supplied to China (1000 cubic meters)	Supply (Total Volume of Gas Production) (1000 cubic meters)	Quantity of Gas Supplied to Domestic Market (1000 cubic meters)	Value of Exports Net of Wellhead Price and transport cost (USD Real)	Royalty Payment (USD Real)	Domestic Demand Natural Gas (1000 cubic meters)	Domestic Demand plus Export Demand Natural Gas (1000 cubic meters)	Available Proven Reserves (1000 cubic meters)	Amount Needed to Meet Domestic Volume of Gas Demand (1000 cubic meters)	Quantity of Required Gas Imports (1000 cubic meters)	Gas Imports expressed in coal equivalence (Ton)	Value of Coal Imports (Net of Production Costs) (USD Real)
2012	300,00	8700,00	4000,00	62911,00	49911,00	2199650,00	948665,00	49911,00	62911,00	3296900,00	0,00	0,00	0,00	0,00
2013	145,00	7500,00	10000,00	63634,48	45989,48	4310688,85	954517,15	45989,48	63634,48	3233265,52	0,00	0,00	0,00	0,00
2014	145,00	7500,00	10000,00	64366,27	46721,27	4310688,85	965494,09	46449,37	64094,37	3168899,25	-271,90	-271,90	-115,18	-3595,09
2015	145,00	7500,00	10000,00	65106,49	47461,49	4310688,85	976597,28	46913,86	64558,86	3103792,77	-547,62	-547,62	-231,98	-27381,01
2016	145,00	7500,00	25000,00	65855,21	33210,21	8152638,85	987828,15	47383,00	80028,00	3037937,56	14172,79	14172,79	6003,87	708639,70
2017	145,00	7500,00	25000,00	67172,31	34527,31	8152638,85	1007584,71	47714,68	80359,68	2970765,24	13187,37	13187,37	5586,43	659368,54
2018	145,00	7500,00	25000,00	68515,76	35870,76	8152638,85	1027736,40	48048,69	80693,69	2902249,48	12177,93	12177,93	5158,81	608896,36
2019	145,00	7500,00	25000,00	69886,08	37241,08	8152638,85	1048291,13	48385,03	81030,03	2832363,41	11143,95	11143,95	4720,79	557197,64
2020	145,00	7500,00	25000,00	71283,80	38638,80	8152638,85	1069256,95	48723,72	81368,72	2761079,61	10084,93	10084,93	4272,17	504246,33
2021	145,00	7500,00	25000,00	72709,47	40064,47	8152638,85	1090642,09	49064,79	81709,79	2688370,14	9000,32	9000,32	3812,71	450015,84
2022	145,00	7500,00	25000,00	73232,98	40587,98	8152638,85	1098494,72	50046,09	82691,09	2615137,16	9458,10	9458,10	4006,64	472905,21
2023	145,00	7500,00	25000,00	73760,26	41115,26	8152638,85	1106403,88	51047,01	83692,01	2541376,90	9931,75	9931,75	4207,28	496587,43
2024	145,00	7500,00	25000,00	74291,33	41646,33	8152638,85	1114369,99	52067,95	84712,95	2467085,56	10421,61	10421,61	4414,80	521080,74
2025	145,00	7500,00	25000,00	74826,23	42181,23	8152638,85	1122393,45	53109,31	85754,31	2392259,33	10928,08	10928,08	4629,34	546403,81
2026	145,00	7500,00	25000,00	75364,98	42719,98	8152638,85	1130474,68	54171,49	86816,49	2316894,36	11451,51	11451,51	4851,08	572575,67
2027	145,00	7500,00	25000,00	75907,61	43262,61	8152638,85	1138614,10	55254,92	87899,92	2240986,75	11992,32	11992,32	5080,18	599615,77
2028	145,00	7500,00	25000,00	76454,14	43809,14	8152638,85	1146812,12	56360,02	89005,02	2164532,61	12550,88	12550,88	5316,79	627543,95
2029	145,00	7500,00	25000,00	77004,61	44359,61	8152638,85	1155069,17	57487,22	90132,22	2087528,00	13127,61	13127,61	5561,11	656380,48
2030	145,00	7500,00	25000,00	77559,04	44914,04	8152638,85	1163385,67	58636,97	91281,97	2009968,95	13722,92	13722,92	5813,29	686146,05
2031	145,00	7500,00	25000,00	78117,47	45472,47	8152638,85	1171762,04	59809,70	92454,70	1931851,48	14337,24	14337,24	6073,53	716861,75
2032	145,00	7500,00	25000,00	78679,92	46034,92	8152638,85	1180198,73	61005,90	93650,90	1853171,57	14970,98	14970,98	6342,00	748549,17
2033	145,00	7500,00	25000,00	79246,41	46601,41	8152638,85	1188696,16	62226,02	94871,02	1773925,16	15624,61	15624,61	6618,89	781230,30
2034	145,00	7500,00	25000,00	79816,98	47171,98	8152638,85	1197254,77	63470,54	96115,54	1694108,17	16298,55	16298,55	6904,38	814927,61
2035	145,00	7500,00	25000,00	80391,67	47746,67	8152638,85	1205875,01	64739,95	97384,95	1613716,50	16993,28	16993,28	7198,68	849664,03
2036	145,00	7500,00	25000,00	80970,49	48325,49	8152638,85	1214557,31	66034,75	98679,75	1532746,02	17709,26	17709,26	7501,98	885462,98
2037	145,00	7500,00	25000,00	81553,47	48908,47	8152638,85	1223302,12	67355,44	100000,44	1451192,54	18446,97	18446,97	7814,49	922348,35
2038	145,00	7500,00	25000,00	82140,66	49495,66	8152638,85	1232109,90	68702,55	101347,55	1369051,88	19206,89	19206,89	8136,41	960344,54
2039	145,00	7500,00	25000,00	82732,07	50087,07	8152638,85	1240981,09	70076,60	102721,60	1286319,81	19989,53	19989,53	8467,95	999476,45
2040	145,00	7500,00	25000,00	83327,74	50682,74	8152638,85	1249916,15	71478,13	104123,13	1202992,07	20795,39	20795,39	8809,33	1039769,51
2041	145,00	7500,00	25000,00	83927,70	51282,70	8152638,85	1258915,55	72907,70	105552,70	1119064,36	21624,99	21624,99	9160,77	1081249,65
2042	145,00	7500,00	25000,00	84531,98	51886,98	8152638,85	1267979,74	74365,85	107010,85	1034532,38	22478,87	22478,87	9522,48	1123943,38
2043	145,00	7500,00	25000,00	85140,61	52495,61	8152638,85	1277109,19	75853,17	108498,17	949391,77	23357,55	23357,55	9894,71	1167877,71
2044	145,00	7500,00	25000,00	85753,63	53108,63	8152638,85	1286304,38	77370,23	110015,23	863658,14	24261,61	24261,61	10277,68	1213080,26
2045	145,00	7500,00	25000,00	86371,05	53726,05	8152638,85	1295565,77	78917,64	111562,64	777267,09	25191,58	25191,58	10671,64	1259579,19
2046	145,00	7500,00	25000,00	86992,92	54347,92	8152638,85	1304893,84	80495,99	113140,99	690274,17	26148,06	26148,06	11076,83	1307403,24
2047	145,00	7500,00	25000,00	87619,27	54974,27	8152638,85	1314289,08	82105,91	114750,91	602654,90	27131,64	27131,64	11493,49	1356581,78
2048	145,00	7500,00	25000,00	88250,13	55605,13	8152638,85	1323751,96	83748,03	116393,03	514404,77	28142,89	28142,89	11921,87	1407144,75
2049	145,00	7500,00	25000,00	88885,53	56240,53	8152638,85	1333282,98	85422,99	118067,99	425519,23	29182,45	29182,45	12362,25	1459122,73
2050	145,00	7500,00	25000,00	89525,51	56880,51	8152638,85	1342882,61	87131,45	119776,45	335993,73	30250,94	30250,94	12814,88	1512546,92
2051	145,00	7500,00	25000,00	90170,09	57525,09	8152638,85	1352551,37	88874,07	121519,07	245823,64	31348,98	31348,98	13280,04	1567449,18
2052	145,00	7500,00	25000,00	90819,32	58174,32	8152638,85	1362289,74	90651,56	123296,56	155004,32	32477,24	32477,24	13757,99	1623862,03
2053	145,00	7500,00	25000,00	91473,21	58828,21	8152638,85	1372098,22	92464,59	125109,59	63531,11	-29894,73	-29894,73	-12663,99	-1494736,63
2054	0,00	0,00	0,00	63531,11	63531,11	0,00	952966,58	94313,88	94313,88	0,00	30782,77	30782,77	13040,18	1539138,70
2055	0,00	0,00	0,00	0,00	0,00	0,00	0,00	96200,16	96200,16	0,00	96200,16	96200,16	40752,25	4810007,84
2056	0,00	0,00	0,00	0,00	0,00	0,00	0,00	98124,16	98124,16	0,00	98124,16	98124,16	41567,29	4906208,00
2057	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100086,64	100086,64	0,00	100086,64	100086,64	42398,64	5004332,16
2058	0,00	0,00	0,00	0,00	0,00	0,00	0,00	102088,38	102088,38	0,00	102088,38	102088,38	43246,61	5104418,80
2059	0,00	0,00	0,00	0,00	0,00	0,00	0,00	104130,14	104130,14	0,00	104130,14	104130,14	44111,54	5206507,18
2060	0,00	0,00	0,00	0,00	0,00	0,00	0,00	106212,75	106212,75	0,00	106212,75	106212,75	44993,77	5310637,32
2061	0,00	0,00	0,00	0,00	0,00	0,00	0,00	108337,00	108337,00	0,00	108337,00	30212,67	12798,67	1510633,69
2062	0,00	0,00	0,00	0,00	0,00	0,00	0,00	110503,74	110503,74	0,00	110503,74	0,00	0,00	0,00
2063	0,00	0,00	0,00	0,00	0,00	0,00	0,00	112713,82	112713,82	0,00	112713,82	0,00	0,00	0,00
2064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	114968,09	114968,09	0,00	114968,09	0,00	0,00	0,00
2065	0,00	0,00	0,00	0,00	0,00	0,00	0,00	117267,45	117267,45	0,00	117267,45	0,00	0,00	0,00
Total	6.245	316.200	984.000	3.359.811	2.053.366	324.931.993	50.397.165	3.956.920	5.263.365	74.317.567	1.840.022	1.306.445	553.435	65.322.250

Total Export obligations 1.306.445

Present Value of Royalty 10.804.501 USD in real terms
Present Value of Coal imports (Net of Production Costs) 4.691.978 USD in real terms
Present Value of Capital Contribution 71.993.229 USD in real terms

Appendix 7: (cont'd)

Scenario 3. Best-Best-High

SENSITIVITY ANALYSIS

Real Discount rate WACC	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
4%	29.998.506,94	13.766.132,43	162.124.950,05	16.232.374,51
5%	24.238.092,87	11.402.367,82	131.577.190,23	12.835.725,05
6%	20.157.532,39	9.564.685,20	109.778.667,85	10.592.847,19
7%	17.183.778,41	8.120.541,93	93.762.029,09	9.063.236,47
8%	14.955.775,54	6.973.366,23	81.656.873,11	7.982.409,31
9%	13.242.145,06	6.052.271,03	72.263.325,18	7.189.874,03
10%	11.891.880,55	5.304.830,75	64.796.909,33	6.587.049,80
11%	10.804.501,41	4.691.978,00	58.734.269,98	6.112.523,40
12%	9.911.778,78	4.184.376,14	53.718.798,43	5.727.402,63
13%	9.166.409,37	3.759.824,89	49.502.182,19	5.406.584,48
14%	8.534.903,12	3.401.393,48	45.907.715,46	5.133.509,65
15%	7.993.054,03	3.096.068,94	42.806.935,32	4.896.985,09

Real Well-head Price of Gas (USD)	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
35	7.563.150,98	3.284.384,60	63.074.369,29	4.278.766,38
40	8.643.601,13	3.753.582,40	61.627.669,52	4.890.018,72
45	9.724.051,27	4.222.780,20	60.180.969,75	5.501.271,06
50	10.804.501,41	4.691.978,00	58.734.269,98	6.112.523,40
55	11.884.951,55	5.161.175,80	57.287.570,22	6.723.775,74
60	12.965.401,69	5.630.373,60	55.840.870,45	7.335.028,08
65	14.045.851,83	6.099.571,40	54.394.170,68	7.946.280,42
70	15.126.301,97	6.568.769,20	52.947.470,91	8.557.532,76
75	16.206.752,11	7.037.967,00	51.500.771,15	9.168.785,10

Percentage Change of Real Export Prices	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
-10%	10.804.501,41	4.691.978,00	46.555.303,80	6.112.523,40
-5%	10.804.501,41	4.691.978,00	52.509.787,77	6.112.523,40
-2%	10.804.501,41	4.691.978,00	56.212.077,31	6.112.523,40
-1%	10.804.501,41	4.691.978,00	57.467.773,68	6.112.523,40
0%	10.804.501,41	4.691.978,00	58.734.269,98	6.112.523,40
1%	10.804.501,41	4.691.978,00	60.011.566,22	6.112.523,40
2%	10.804.501,41	4.691.978,00	61.299.662,38	6.112.523,40
5%	10.804.501,41	4.691.978,00	65.228.750,44	6.112.523,40
10%	10.804.501,41	4.691.978,00	71.993.229,14	6.112.523,40

APPENDIX 8
Scenario 3a. High-Low-High

TABLE OF PARAMETERS

Prices, as of 2012
Well Head Price of gas	50,00 USD / 1000 m3
Well head price of natural gas in Coal equivalence	118,03 USD / Ton of coal (including transportation cost)
Percentage Change of Real Export Prices	0% *Base case scenario

Royalty Rate
	30% "Uztransgas" JS Company
WACC	11% *estimated (not constant over time)

Kwh generated per unit of fuel used	1870 kWh per Ton of Coal
	125 kwh per 1000 cubic feet of natural gas

Conversion	0,423619328 Ton of Coal per 1000 cm of Natural Gas
Factor	

Production Costs
Production Cost	35,00 ($/1000m3)
Production cost in coal equivalence / ton	82,6 ($/Ton of coal)
Worth of 1 Ton coal in terms of Well Head Price net of Production costs of Natural Gas	35,4 ($/Ton of coal)

	Bmc	Probability	Recoverable Reserves (bmc)
Total Proven Reserves	1.841,00	90%	1.656,90
Probable Natural Gas Resources	2.100,00	50%	1.050,00
Possible Natural Gas Resources	5.900,00	10%	590,00

Conversions
1 bmc (billion cubic metres)	1.000.000.000 mc (cubic metre)
1000 m3 or thousand mc	1.000 cubic metres
1 cubic foot	0,0283168 cubic metres
1 Tcf (Trillion cubic feet)	28,3 bmc

UZBEKISTAN NATURAL GAS DEMAND/SUPPLY MODULE

Data as of Year 2012
	Russia	Tajikistan	Kyrgyzistan	China
Export Price ($/1000m3)	253	253	300	290	140
Export Volume (bcm)	8,7	0,155	0,145	4
Total Revenu USD	2.201.100.000	46.500.000	42.050.000	560.000.000

Contribution of Export Price to Capital Recovery (per 1000m3) As of 2012	203,00	250,00	240,00	90,00

Total Value of Contribution USD	1.766.100	38.750	34.800	360.000

*Demand/Supply assumptions table
	Russia	Tajikistan	Kyrgyzistan	China	Supply (Production)	Domestic Demand	Export Capacity
Total Volume (1000 m3 as of 2012)	8.700	155	145	4.000	62.911	49.911	13.000
Total Volume (1000 m3 as of 2013)	7.500	0,00	145	10.000	63.634	45.989	17.645
Short term annual growth rate (2012-2016)	0%	0%	0%	0%	1,15%	1,00%	1,72%
Medium term annual growth rate (2016-2021)	0%	0%	0%	25.000	2,0%	0,70%	7,76%
Longer term annual growth rate (up to 2050)	0%	0%	0%	0%	-1%	3%	#NUM!

Data as of Year 2013
	Russia	Tajikistan	Kyrgyzistan	China
	253	253	300	253	253
	7,5	0	0,145	10
	##################	##################	0	36.685.000	2.530.000.000

	203,00	250,00	203,00	203,00

	1.522.500	0	29.435	2.030.000

Cost-Benefit Analysis of Natural Gas Exports

Year	Quantity of Gas Supplied to Tajikistan and Kyrgyzstan (1000 cubic meters)	Quantity of Gas Supplied to Russia (1000 cubic meters)	Quantity of Gas Supplied to China (1000 cubic meters)	Supply (Total Volume of Gas Production) (1000 cubic meters)	Quantity of Gas Supplied to Domestic Market (1000 cubic meters)	Value of Exports Net of Wellhead Price and transport cost (USD Real)	Royalty Payment (USD Real)	Domestic Demand Natural Gas (1000 cubic meters)	Domestic Demand plus Export Demand Natural Gas (1000 cubic meters)	Available 3P Reserves (1000 cubic meters)	Amount Needed to Meet Domestic Volume of Gas Demand (1000 cubic meters)	Quantity of Required Gas Imports (1000 cubic meters)	Gas Imports expressed in coal equivalence (Ton)	Value of Coal Imports (Net of Production Costs) (USD Real)
2012	300,00	8700,00	4000,00	62911,00	49911,00	2199650,00	943665,00	49911,00	62911,00	3296900,00	0,00	0,00	0,00	0,00
2013	145,00	7500,00	10000,00	63634,48	45989,48	3581935,00	954517,15	45989,48	63634,48	3233265,52	0,00	0,00	0,00	0,00
2014	145,00	7500,00	10000,00	64366,27	46721,27	3581935,00	965494,09	46449,37	64094,37	3168899,25	-271,90	-271,90	-115,18	-13595,09
2015	145,00	7500,00	10000,00	65106,49	47461,49	3581935,00	976597,28	46913,86	64558,86	3103792,77	-547,62	-547,62	-231,98	-27381,01
2016	145,00	7500,00	25000,00	65855,21	33210,21	6626935,00	987828,15	47383,00	80028,00	3037937,56	14172,79	14172,79	6003,87	708639,70
2017	145,00	7500,00	25000,00	67172,31	34527,31	6626935,00	1007584,71	47714,68	80359,68	2970765,24	13187,37	13187,37	5586,43	659368,54
2018	145,00	7500,00	25000,00	68515,76	35870,76	6626935,00	1027736,40	48048,69	80693,69	2902249,48	12177,93	12177,93	5158,81	608896,36
2019	145,00	7500,00	25000,00	69886,08	37241,08	6626935,00	1048291,13	48385,03	81030,03	2832363,41	11143,95	11143,95	4720,79	557197,64
2020	145,00	7500,00	25000,00	71283,80	38638,80	6626935,00	1069256,95	48723,72	81368,72	2761079,61	10084,93	10084,93	4272,17	504246,33
2021	145,00	7500,00	25000,00	72709,47	40064,47	6626935,00	1090642,09	49064,79	81709,79	2688370,14	9000,32	9000,32	3812,71	450015,84
2022	145,00	7500,00	25000,00	71975,11	39330,11	6626935,00	1079626,61	50492,57	83137,57	2616395,03	11162,47	11162,47	4728,64	558123,39
2023	145,00	7500,00	25000,00	71248,16	38603,16	6626935,00	1068722,38	51961,91	84606,91	2545146,87	13358,75	13358,75	5659,02	667937,51
2024	145,00	7500,00	25000,00	70528,55	37883,55	6626935,00	1057928,28	53474,00	86119,00	2476188,32	15590,45	15590,45	6604,42	779522,41
2025	145,00	7500,00	25000,00	69816,21	37171,21	6626935,00	1047243,21	55030,09	87675,09	2404802,10	17858,88	17858,88	7565,37	892944,00
2026	145,00	7500,00	25000,00	69111,07	36466,07	6626935,00	1036666,05	56631,47	89276,47	2335691,03	20165,40	20165,40	8542,45	1008269,97
2027	145,00	7500,00	25000,00	68413,05	35768,05	6626935,00	1026195,72	58279,45	90924,45	2267277,99	22511,40	22511,40	9536,26	1125569,85
2028	145,00	7500,00	25000,00	67722,08	35077,08	6626935,00	1015831,15	59975,38	92620,38	2199555,91	24898,30	24898,30	10547,40	1244915,04
2029	145,00	7500,00	25000,00	67038,08	34393,08	6626935,00	1005571,25	61720,66	94365,66	2137517,83	27327,58	27327,58	11576,49	1366378,86
2030	145,00	7500,00	25000,00	66361,00	33716,00	6626935,00	995414,98	63516,73	96161,73	2066156,83	29800,73	29800,73	12624,17	1490036,65
2031	145,00	7500,00	25000,00	65690,75	33045,75	6626935,00	985361,29	65365,07	98010,07	2000466,08	32319,32	32319,32	13691,09	1615965,80
2032	145,00	7500,00	25000,00	65027,28	32382,28	6626935,00	975409,14	67267,19	99912,19	1935438,80	34884,92	34884,92	14777,92	1744245,81
2033	145,00	7500,00	25000,00	64370,50	31725,50	6626935,00	965557,51	69224,67	101869,67	1871068,30	37499,17	37499,17	15885,37	1874958,34
2034	145,00	7500,00	25000,00	63720,36	31075,36	6626935,00	955805,38	71239,11	103884,11	1807347,94	40163,75	40163,75	17014,14	2008187,34
2035	145,00	7500,00	25000,00	63076,78	30431,78	6626935,00	946151,74	73312,16	105957,16	1744271,16	42880,38	42880,38	18164,96	2140019,02
2036	145,00	7500,00	25000,00	62439,71	29794,71	6626935,00	936595,61	75445,55	108090,55	1681831,45	45650,84	45650,84	19338,58	2282541,99
2037	145,00	7500,00	25000,00	61809,07	29164,07	6626935,00	927136,00	77641,01	110286,01	1620022,38	48476,95	48476,95	20535,77	2423847,31
2038	145,00	7500,00	25000,00	61184,79	28539,79	6626935,00	917771,92	79900,37	112545,37	1558837,59	51360,57	51360,57	21757,33	2568028,57
2039	145,00	7500,00	25000,00	60566,83	27921,83	6626935,00	908502,43	82225,47	114870,47	1498270,76	54303,64	54303,64	23004,07	2715181,92
2040	145,00	7500,00	25000,00	59955,10	27310,10	6626935,00	899326,55	84618,23	117263,23	1438315,66	57308,12	57308,12	24276,83	2865406,22
2041	145,00	7500,00	25000,00	59349,56	26704,56	6626935,00	890243,35	87080,62	119725,62	1378966,10	60376,06	60376,06	25576,47	3018803,07
2042	145,00	7500,00	25000,00	58750,13	26105,13	6626935,00	881251,90	89614,66	122259,66	1320215,97	63509,54	63509,54	26903,87	3175476,90
2043	145,00	7500,00	25000,00	58156,75	25511,75	6626935,00	872351,25	92222,45	124867,45	1262059,22	66710,70	66710,70	28259,94	3335535,05
2044	145,00	7500,00	25000,00	57569,37	24924,37	6626935,00	863540,50	94906,12	127551,12	1204489,86	69981,76	69981,76	29645,63	3499087,87
2045	145,00	7500,00	25000,00	56987,92	24342,92	6626935,00	854818,74	97667,89	130312,89	1147501,94	73324,98	73324,98	31061,88	3666248,81
2046	145,00	7500,00	25000,00	56412,34	23767,34	6626935,00	846185,08	100510,03	133155,03	1091089,60	76742,69	76742,69	32509,69	3837134,50
2047	145,00	7500,00	25000,00	55842,57	23197,57	6626935,00	837638,61	103434,87	136079,87	1035247,03	80237,30	80237,30	33990,07	4011864,82
2048	145,00	7500,00	25000,00	55278,56	22633,56	6626935,00	829178,46	106444,82	139089,82	979968,46	83811,26	83811,26	35504,07	4190563,05
2049	145,00	7500,00	25000,00	54720,25	22075,25	6626935,00	820803,75	109542,37	142187,37	925248,21	87467,12	87467,12	37052,76	4373355,95
2050	145,00	7500,00	25000,00	54167,58	21522,58	6626935,00	812513,64	112730,05	145375,05	871080,64	91207,48	91207,48	38637,25	4560373,82
2051	145,00	7500,00	25000,00	53620,48	20975,48	6626935,00	804307,25	116010,50	148655,50	817460,15	95035,01	95035,01	40258,67	4751750,67
2052	145,00	7500,00	25000,00	53078,92	20433,92	6626935,00	796183,74	119386,40	152031,40	764381,24	98952,49	98952,49	41918,19	4947624,29
2053	145,00	7500,00	25000,00	52542,82	19897,82	6626935,00	788142,29	122860,55	155505,55	711838,42	102962,73	54362,90	23027,63	2717962,88
2054	145,00	7500,00	25000,00	52012,14	19367,14	6626935,00	780182,05	126435,79	159080,79	659826,28	107068,65	0,00	0,00	0,00
2055	145,00	7500,00	25000,00	51486,81	18841,81	6626935,00	772302,21	130115,07	162760,07	608339,47	111273,26	0,00	0,00	0,00
2056	145,00	7500,00	25000,00	50966,80	18321,80	6626935,00	764501,96	133901,42	166546,42	557372,67	115579,62	0,00	0,00	0,00
2057	145,00	7500,00	25000,00	50452,03	17807,03	6626935,00	756780,49	137797,95	170442,95	506920,64	119990,92	0,00	0,00	0,00
2058	145,00	7500,00	25000,00	49942,47	17297,47	6626935,00	749137,01	141807,87	174452,87	456978,17	124510,40	0,00	0,00	0,00
2059	145,00	7500,00	25000,00	49438,05	16793,05	6626935,00	741570,72	145934,48	178579,48	407540,12	129141,43	0,00	0,00	0,00
2060	145,00	7500,00	25000,00	48938,72	16293,72	6626935,00	734080,86	150181,17	182826,17	358601,40	133887,45	0,00	0,00	0,00
2061	145,00	7500,00	25000,00	48444,44	15799,44	6626935,00	726666,64	154551,44	187196,44	310156,96	138752,00	0,00	0,00	0,00
2062	145,00	7500,00	25000,00	47955,15	15310,15	6626935,00	719327,31	159048,89	191693,89	262201,80	143738,74	0,00	0,00	0,00
2063	145,00	7500,00	25000,00	47470,81	14825,81	6626935,00	712062,10	163677,21	196322,21	214730,99	148851,41	0,00	0,00	0,00
2064	145,00	7500,00	25000,00	46991,35	14346,35	6626935,00	704870,28	168440,22	201085,22	167739,64	-13645,77	0,00	0,00	0,00
2065	145,00	7500,00	25000,00	46516,74	13871,74	6626935,00	697751,09	173341,83	205986,83	121222,90	-3847,19	0,00	0,00	0,00
Total	7.985	406.200	1.284.000	3.238.588	1.540.403	344.292.205	48.578.821	4.873.549	6.571.734	86.334.833	3.044.184	1.698.185	719.384	84.909.250

Total Export Obligations: 1.698.185

Residual Reserves: 121.223

Present Value of Royalty: 10.229.527 USD in real terms
Present Value of Coal imports (Net of Production Costs): 7.816.751 USD in real terms
Present Value of Capital Contribution: 59.711.223 USD in real terms

Appendix 8: (cont'd)

Scenario 3a. High-Low-High

SENSITIVITY ANALYSIS

Real Discount rate WACC	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
4%	27.837.183,80	29.815.275,28	185.027.134,29	- 1.978.091,48
5%	22.436.750,11	23.811.005,46	145.910.885,65	- 1.374.255,35
6%	18.665.573,43	19.236.533,94	118.805.045,80	- 570.960,50
7%	15.951.923,45	15.719.500,75	99.480.765,35	232.422,70
8%	13.939.626,73	12.990.521,66	85.301.677,08	949.105,07
9%	12.403.395,72	10.853.387,92	74.599.962,95	1.550.007,79
10%	11.198.331,37	9.164.212,32	66.303.538,99	2.034.119,05
11%	10.229.526,78	7.816.751,26	59.711.222,87	2.412.775,52
12%	9.433.588,43	6.732.013,80	54.355.808,28	2.701.574,64
13%	8.767.282,86	5.850.862,85	49.919.798,04	2.916.420,01
14%	8.200.480,72	5.128.716,23	46.182.959,87	3.071.764,49
15%	7.711.717,38	4.531.729,44	42.989.292,48	3.179.987,94

Real Well-head Price of Gas (USD)	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
35	7.160.668,74	5.471.725,88	64.123.510,81	1.688.942,86
40	8.183.621,42	6.253.401,01	62.652.748,16	1.930.220,41
45	9.206.574,10	7.035.076,13	61.181.985,52	2.171.497,97
50	10.229.526,78	7.816.751,26	59.711.222,87	2.412.775,52
55	11.252.479,45	8.598.426,38	58.240.460,22	2.654.053,07
60	12.275.432,13	9.380.101,51	56.769.697,58	2.895.330,62
65	13.298.384,81	10.161.776,64	55.298.934,93	3.136.608,17
70	14.321.337,49	10.943.451,76	53.828.172,29	3.377.885,72
75	15.344.290,16	11.725.126,89	52.357.409,64	3.619.163,28

Percentage Change of Real Export Prices	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
-10%	10.229.526,78	7.816.751,26	47.326.092,08	2.412.775,52
-5%	10.229.526,78	7.816.751,26	53.381.313,73	2.412.775,52
-2%	10.229.526,78	7.816.751,26	57.146.296,72	2.412.775,52
-1%	10.229.526,78	7.816.751,26	58.423.266,04	2.412.775,52
0%	10.229.526,78	7.816.751,26	59.711.222,87	2.412.775,52
1%	10.229.526,78	7.816.751,26	61.010.167,20	2.412.775,52
2%	10.229.526,78	7.816.751,26	62.320.099,02	2.412.775,52
5%	10.229.526,78	7.816.751,26	66.315.819,50	2.412.775,52
10%	10.229.526,78	7.816.751,26	73.195.103,62	2.412.775,52

TABLE OF PARAMETERS

Prices, as of 2012

Well Head Price of gas	50,00	USD / 1000 m3
Well head price of natural gas in Coal equivalence	118,03	USD / Ton of coal (including transportation cost)
Percentage Change of Real Export Prices	10%	*Base case scenario

Royalty Rate

	30%	"Uztransgas" JS Company
WACC	11%	*estimated (not constant over time)

Kwh generated per unit of fuel used	1870	kWh per Ton of Coal
	125	kwh per 1000 cubic feet of natural gas

Conversion Factor	0,423619328	Ton of Coal per 1000 cm of Natural Gas

Production Costs

Production Cost	35,00	($/1000m3)
Production cost in coal equivalence / ton	82,6	($/Ton of coal)
Worth of 1 Ton coal in terms of Well Head Price net of Production costs of Natural Gas	35,4	($/Ton of coal)

	Bmc	Probability	Recoverable Reserves (bmc)
Total Proven Reserves	1.841,00	90%	1.656,90
Probable Natural Gas Resources	2.100,00	50%	1.050,00
Possible Natural Gas Resources	5.900,00	10%	590,00

Conversions

1 bmc (billion cubic metres)	1.000.000.000	mc (cubic metre)
1000 m3 or thousand mc	1.000	cubic metres
1 cubic foot	0,0283168	cubic metres
1 Tcf (Trillion cubic feet)	28,3	bmc

UZBEKISTAN NATURAL GAS DEMAND/SUPPLY MODULE

	Data as of Year 2012					Data as of Year 2013			
	Russia	Tajikistan	Kyrgyzistan	China		Russia	Tajikistan	Kyrgyzistan	China
Export Price ($/1000m3)	253	300	290	140		278,3	330	306,13	306,13
Export Volume (bcm)	8,7	0,155	0,145	4		7,5	0	0,145	10
Total Revenu USD	2.201.100.000	46.500.000	42.050.000	560.000.000		2.087.250.000		44.388.850	3.061.300.000
Contribution of Export Price to Capital Recovery (per 1000m3) As of 2012	203,00	250,00	240,00	90,00		228,30	280,00	256,13	256,13
Total Value of Contribution USD	1.766.100	38.750	34.800	360.000		1.712.250	0	37.139	2.561.300

*Demand/Supply assumptions table	Russia	Tajikistan	Kyrgyzistan	China	Supply (Production)	Domestic Demand	Export Capacity
Total Volume (1000 m3 as of 2012)	8.700	155	145	4.000	62.911	49.911	13.000
Total Volume (1000 m3 as of 2013)	7.500	0,00	145	10.000	63.634	45.989	17.645
Short term annual growth rate (2012-2016)	0%	0%	0%	0%	1,15%	1,00%	1,72%
Medium term annual growth rate (2016-2021)	0%	0%	0%	0%	2,0%	0,70%	7,76%
Longer term annual growth rate (up to 2050)	0%	0%	0%	0%	0,9%	-1%	14,52%

APPENDIX 9: (cont'd)
Scenario 3b. Low-High-High

Cost-Benefit Analysis of Natural Gas Exports

Year	Quantity of Gas Supplied to Tajikistan and Kyrgyzstan (1000 cubic meters)	Quantity of Gas Supplied to Russia (1000 cubic meters)	Quantity of Gas Supplied to China (1000 cubic meters)	Supply (Total Volume of Gas Production) (1000 cubic meters)	Quantity of Gas Supplied to Domestic Market (1000 cubic meters)	Value of Exports Net of Wellhead Price and transport cost (USD Real)	Royalty Payment (USD Real)	Domestic Demand Natural Gas (1000 cubic meters)	Domestic Demand plus Export Demand Natural Gas (1000 cubic meters)	Available Proven Reserves (1000 cubic meters)	Amount Needed to Meet Domestic Volume of Gas Demand (1000 cubic meters)	Quantity of Required Gas Imports (1000 cubic meters)	Gas Imports expressed in coal equivalence (Ton)	Value of Coal Imports (Net of Production Costs) (USD Real)
2012	300,00	8700,00	4000,00	62911,00	49911,00	2199650,00	943665,00	49911,00	62911,00	3296900,00	0,00	0,00	0,00	0,00
2013	145,00	7500,00	10000,00	63634,48	45989,48	4310688,85	954517,15	45989,48	63634,48	3233265,52	0,00	0,00	0,00	0,00
2014	145,00	7500,00	10000,00	64366,27	46721,27	4310688,85	965494,09	46449,37	64094,37	3168899,25	-271,90	-271,90	-115,18	-13595,09
2015	145,00	7500,00	10000,00	65106,49	47461,49	4310688,85	976597,28	46913,86	64558,86	3103792,77	-547,62	-547,62	-231,98	-27381,01
2016	145,00	7500,00	25000,00	65855,21	33210,21	8152638,85	987828,15	47383,00	80028,00	3037937,56	14172,79	14172,79	6003,87	708639,70
2017	145,00	7500,00	25000,00	67172,31	34527,31	8152638,85	1007584,71	47714,68	80359,68	2970765,24	13187,37	13187,37	5586,43	659368,54
2018	145,00	7500,00	25000,00	68515,76	35870,76	8152638,85	1027736,40	48048,69	80693,69	2902249,48	12177,93	12177,93	5158,81	608896,36
2019	145,00	7500,00	25000,00	69886,08	37241,08	8152638,85	1048291,13	48385,03	81030,03	2832363,41	11143,95	11143,95	4720,79	557197,64
2020	145,00	7500,00	25000,00	71283,80	38638,80	8152638,85	1069256,95	48723,72	81368,72	2761079,61	10084,93	10084,93	4272,17	504246,33
2021	145,00	7500,00	25000,00	72709,47	40064,47	8152638,85	1090642,09	49064,79	81709,79	2688370,14	9000,32	9000,32	3812,71	450015,84
2022	145,00	7500,00	25000,00	73356,59	40711,59	8152638,85	1100348,81	48422,04	81067,04	2615013,55	7710,45	7710,45	3266,30	385522,68
2023	145,00	7500,00	25000,00	74009,46	41364,46	8152638,85	1110141,91	47787,71	80432,71	2541004,09	6423,25	6423,25	2721,01	321162,56
2024	145,00	7500,00	25000,00	74668,14	42023,14	8152638,85	1120022,17	47161,69	79806,69	2466335,94	5138,55	5138,55	2176,79	256927,40
2025	145,00	7500,00	25000,00	75332,69	42687,69	8152638,85	1129990,37	46543,87	79188,87	2391003,25	3856,18	3856,18	1633,55	192809,17
2026	145,00	7500,00	25000,00	76003,15	43358,15	8152638,85	1140047,29	45934,15	78579,15	2315000,10	2576,00	2576,00	1091,24	128799,88
2027	145,00	7500,00	25000,00	76679,58	44034,58	8152638,85	1150193,71	45332,41	77977,41	2238320,52	1297,83	1297,83	549,79	64891,61
2028	145,00	7500,00	25000,00	77362,03	44717,03	8152638,85	1160430,43	44738,56	77383,56	2160958,49	21,53	21,53	9,12	1076,47
2029	145,00	7500,00	25000,00	78050,55	45405,55	8152638,85	1170758,26	44152,48	76797,48	2082907,94	-1253,07	-1253,07	-530,82	-62653,39
2030	145,00	7500,00	25000,00	78745,20	46100,20	8152638,85	1181178,01	43574,09	76219,09	2004162,74	-2526,12	-2526,12	-1070,11	-126305,76
2031	145,00	7500,00	25000,00	79446,03	46801,03	8152638,85	1191690,49	43003,26	75648,26	1924716,71	-3797,77	-3797,77	-1608,81	-189888,40
2032	145,00	7500,00	25000,00	80153,10	47508,10	8152638,85	1202296,54	42439,92	75084,92	1844563,60	-5068,18	-5068,18	-2146,98	-253409,02
2033	145,00	7500,00	25000,00	80866,47	48221,47	8152638,85	1212996,98	41883,96	74528,96	1763697,14	-6337,51	-6337,51	-2684,69	-316875,30
2034	145,00	7500,00	25000,00	81586,18	48941,18	8152638,85	1223792,65	41335,28	73980,28	1682110,96	-7605,90	-7605,90	-3222,01	-380294,87
2035	145,00	7500,00	25000,00	82312,29	49667,29	8152638,85	1234684,41	40793,79	73438,79	1599798,67	-8873,51	-8873,51	-3758,99	-443675,33
2036	145,00	7500,00	25000,00	83044,87	50399,87	8152638,85	1245673,10	40259,39	72904,39	1516753,79	-10140,48	-10140,48	-4295,71	-507024,23
2037	145,00	7500,00	25000,00	83783,97	51138,97	8152638,85	1256759,59	39731,99	72376,99	1432969,82	-11406,98	-11406,98	-4832,22	-570349,10
2038	145,00	7500,00	25000,00	84529,65	51884,65	8152638,85	1267944,75	39211,50	71856,50	1348440,17	-12673,15	-12673,15	-5368,59	-633657,42
2039	145,00	7500,00	25000,00	85281,96	52636,96	8152638,85	1279229,46	38697,83	71342,83	1263158,21	-13939,13	-13939,13	-5904,89	-696956,65
2040	145,00	7500,00	25000,00	86040,97	53395,97	8152638,85	1290614,60	38190,89	70835,89	1177117,24	-15205,08	-15205,08	-6441,17	-760254,20
2041	145,00	7500,00	25000,00	86806,74	54161,74	8152638,85	1302101,07	37690,59	70335,59	1090310,50	-16471,15	-16471,15	-6977,50	-823557,47
2042	145,00	7500,00	25000,00	87579,32	54934,32	8152638,85	1313689,77	37196,84	69841,84	1002731,18	-17737,48	-17737,48	-7513,94	-886873,80
2043	145,00	7500,00	25000,00	88358,77	55713,77	8152638,85	1325381,61	36709,56	69354,56	914372,41	-19004,21	-19004,21	-8050,55	-950210,53
2044	145,00	7500,00	25000,00	89145,17	56500,17	8152638,85	1337177,50	36228,67	68873,67	825227,24	-20271,50	-20271,50	-8587,40	-1013574,95
2045	145,00	7500,00	25000,00	89938,56	57293,56	8152638,85	1349078,35	35754,07	68399,07	735288,68	-21539,49	-21539,49	-9124,54	-1076974,32
2046	145,00	7500,00	25000,00	90739,01	58094,01	8152638,85	1361085,18	35285,69	67930,69	644549,67	-22808,32	-22808,32	-9662,04	-1140415,90
2047	145,00	7500,00	25000,00	91546,59	58901,59	8152638,85	1373198,84	34823,45	67468,45	553003,08	-24078,14	-24078,14	-10199,96	-1203906,89
2048	145,00	7500,00	25000,00	92361,35	59716,35	8152638,85	1385420,31	34367,26	67012,26	460641,72	-25349,09	-25349,09	-10738,36	-1267454,48
2049	145,00	7500,00	25000,00	93183,37	60538,37	8152638,85	1397750,55	33917,05	66562,05	367458,35	-26621,32	-26621,32	-11277,30	-1331065,84
2050	145,00	7500,00	25000,00	94012,70	61367,70	8152638,85	1410190,53	33472,74	66117,74	273445,65	-27894,96	-27894,96	-11816,85	-1394748,11
2051	145,00	7500,00	25000,00	94849,42	62204,42	8152638,85	1422741,23	33034,25	65679,25	178596,24	-29170,17	-29170,17	-12357,05	-1458808,41
2052	145,00	7500,00	25000,00	95693,57	63048,57	8152638,85	1435403,62	32601,50	65246,50	82902,66	-30447,08	-30447,08	-12897,97	-1523353,83
2053	0,00	0,00	0,00	82902,66	82902,66	0,00	1245539,93	32174,42	32174,42	0,00	-50728,24	50728,24	21489,46	2536412,18
2054	0,00	0,00	0,00	0,00	0,00	0,00	0,00	31752,93	31752,93	0,00	31752,93	31752,93	13451,16	1587646,68
2055	0,00	0,00	0,00	0,00	0,00	0,00	0,00	31336,97	31336,97	0,00	31336,97	31336,97	13274,95	1566848,51
2056	0,00	0,00	0,00	0,00	0,00	0,00	0,00	30926,46	30926,46	0,00	30926,46	30926,46	13101,04	1546322,80
2057	0,00	0,00	0,00	0,00	0,00	0,00	0,00	30521,32	30521,32	0,00	30521,32	30521,32	12929,42	1526065,97
2058	0,00	0,00	0,00	0,00	0,00	0,00	0,00	30121,49	30121,49	0,00	30121,49	30121,49	12760,05	1506074,50
2059	0,00	0,00	0,00	0,00	0,00	0,00	0,00	29726,90	29726,90	0,00	29726,90	29726,90	12592,89	1486344,93
2060	0,00	0,00	0,00	0,00	0,00	0,00	0,00	29337,48	29337,48	0,00	29337,48	29337,48	12427,92	1466873,81
2061	0,00	0,00	0,00	0,00	0,00	0,00	0,00	28953,16	28953,16	0,00	28953,16	28953,16	12265,12	1447657,76
2062	0,00	0,00	0,00	0,00	0,00	0,00	0,00	28573,87	28573,87	0,00	28573,87	28573,87	12104,44	1428693,45
2063	0,00	0,00	0,00	0,00	0,00	0,00	0,00	28199,55	28199,55	0,00	28199,55	28199,55	11945,87	1409977,56
2064	0,00	0,00	0,00	0,00	0,00	0,00	0,00	27830,14	27830,14	0,00	27830,14	27830,14	11789,38	1391506,86
2065	0,00	0,00	0,00	0,00	0,00	0,00	0,00	27465,56	27465,56	0,00	27465,56	27465,56	11634,94	1373278,12
Total	6.100	308.700	959.000	3.359.811	2.086.011	316.779.354	50.397.165	2.105.780	3.379.580	73.492.183	19.769	19.769	8.375	988.469

Total Export obligations   1.273.800

Present Value of Royalty   10.858.559 USD in real terms
Present Value of Coal imports (Net of Production Costs)   1.584.961 USD in real terms
Present Value of Capital Contribution   71.835.507 USD in real terms

Appendix 9: (cont'd)

Scenario 3b. Low-High-High

SENSITIVITY ANALYSIS

Real Discount rate WACC	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
4%	30.136.835,11	- 2.013.364,12	159.915.648,90	32.150.199,23
5%	24.366.118,28	- 818.060,21	130.136.656,66	25.184.178,49
6%	20.272.119,43	23.731,38	108.832.316,73	20.248.388,05
7%	17.284.220,17	612.078,29	93.135.837,65	16.672.141,88
8%	15.042.650,94	1.018.205,06	81.239.665,06	14.024.445,87
9%	13.316.648,35	1.293.041,80	71.983.520,59	12.023.606,55
10%	11.955.437,62	1.473.167,07	64.608.074,54	10.482.270,55
11%	10.858.558,67	1.584.960,55	58.606.064,54	9.273.598,12
12%	9.957.694,37	1.647.519,14	53.631.258,69	8.310.175,23
13%	9.205.404,11	1.674.715,01	49.442.084,08	7.530.689,09
14%	8.568.045,18	1.676.655,12	45.866.242,83	6.891.390,06
15%	8.021.261,80	1.660.721,24	42.778.174,42	6.360.540,56

Real Well-head Price of Gas (USD)	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
35	7.600.991,07	1.109.472,39	62.936.690,53	6.491.518,68
40	8.686.846,94	1.267.968,44	61.493.148,53	7.418.878,49
45	9.772.702,80	1.426.464,50	60.049.606,54	8.346.238,30
50	10.858.558,67	1.584.960,55	58.606.064,54	9.273.598,12
55	11.944.414,54	1.743.456,61	57.162.522,54	10.200.957,93
60	13.030.270,40	1.901.952,67	55.718.980,54	11.128.317,74
65	14.116.126,27	2.060.448,72	54.275.438,54	12.055.677,55
70	15.201.982,14	2.218.944,78	52.831.896,55	12.983.037,36
75	16.287.838,01	2.377.440,83	51.388.354,55	13.910.397,17

Percentage Change of Real Export Prices	Present Value of Royalty (USD)	Present Value of Coal imports (Net of Production Costs) (USD)	Present Value of Capital Contribution (USD)	Net Present Value of Natural Gas Exports (USD)
-10%	10.858.558,67	1.584.960,55	46.454.153,32	9.273.598,12
-5%	10.858.558,67	1.584.960,55	52.395.417,49	9.273.598,12
-2%	10.858.558,67	1.584.960,55	56.089.479,77	9.273.598,12
-1%	10.858.558,67	1.584.960,55	57.342.384,50	9.273.598,12
0%	10.858.558,67	1.584.960,55	58.606.064,54	9.273.598,12
1%	10.858.558,67	1.584.960,55	59.880.519,89	9.273.598,12
2%	10.858.558,67	1.584.960,55	61.165.750,56	9.273.598,12
5%	10.858.558,67	1.584.960,55	65.086.094,46	9.273.598,12
10%	10.858.558,67	1.584.960,55	71.835.507,25	9.273.598,12