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Final Feasibility Report on Industrial Development and Natural Gas Market Development in Afghanistan

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Acronyms and Abbreviations

AEAI	Advanced Engineering Associates International, Inc.
AGE	Afghan Gas Enterprise
AIC	Afghanistan Investment Corporation
BCM	Billion (10^9) Cubic Meter
BP	British Petroleum
BTU	British Thermal Unit, a unit of energy
CAPEX	Capital Expenses
CAPM	Capital Asset Pricing Model
CF	Cubic Feet
CFD	Cubic Feet per Day
CNG	Compressed Natural Gas
CM	Cubic Meter
CMD	Cubic Meter per Day
CSO	Central Statistics Office of Afghanistan
DABS	Da Afghanistan Breshna Sherkat
GDP	Gross Domestic Product
GIRoA	Government Islamic Republic of Afghanistan
IRR	Internal Rate of Return
LDC	Local Distribution Company
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
M	Thousand(10^3)
M CF	Thousand Cubic Feet
M CFD	Thousand Cubic Feet per Day
M CM	Thousand Cubic Meters
M CMD	Thousand Cubic Meters per Day
MEW	Ministry of Energy and Water
MM	Million (10^6)
MM CF	Million Cubic Feet
MM CFD	Million Cubic Feet per Day
MM CM	Million Cubic Meters
MM CMD	Million Cubic Meters per Day
MoMP	Ministry of Mines and Petroleum
MT	Metric Tons
MW	Mega Watt
NCE	Northern Coal Enterprise
NG	Natural Gas
NRVA	National Risk and Vulnerability Assessment (Survey)
OPEX	Operation Expenses
Provinces	1) Balk (Mazar-e-Sharif); 2) Jowzjan (Sheberghan); 3) Samangan; 4) Baghlan; 5) Kunduz; 6) Parwan (Charikar) and; 7) Kabul

PPP	Purchasing Power Parity
PSC	Production Sharing Contracts
Report	Feasibility Report on Industrial Development of NG Market in Afghanistan
SGDP	Sheberghan Gas Development Project
SGGA	Sheberghan Gas Generation Activity
TCF	Trillion (10^{12}) Cubic Feet
USAID	United States Agency for International Development
US$	United States Dollar
USG	United States Government

1 Executive Summary

Background

This "*Final Feasibility Report on Industrial Development and Natural Gas Market Development in Afghanistan*" ("Feasibility Report") is part of USAID's Technical Assistance for a gas development program and a 200-MW power plant in Sheberghan, Afghanistan, which is being performed by the Sheberghan Gas Generation Activity ("SGGA") in 2012 through 2015. This work is part of USAID's Technical Assistance to Afghanistan's Ministry of Mines and Petroleum ("MoMP"), Task Order No. AID-306-TO-12-00002 ("Task Order").

SGGA's scope of work focuses on the support of projects and transactions relevant to the Sheberghan Gas Development Program ("SGDP"). The scope of this task order includes a program to promote sustainability of the projects completed within the SGDP through training and mentoring of the MoMP and other relevant GIRoA institutions such as Da Afghanistan Breshna Sherkat ("DABS") and Ministry of Energy and Water ("MEW"), as mutually agreed to by GIRoA and USAID. This training, mentoring and capacity enhancement program will also provide the basis for the production of a comprehensive feasibility report on industrial development and effective utilization of Afghanistan's hydrocarbon reserves, including, but not limited to, the Sheberghan gas fields in Jowzjan Province in Northern Afghanistan and the creation of a natural gas market in Afghanistan.

In the context of the anticipated considerable gas resource (about 1 TCM) present in the Amu Darya basin in northern Afghanistan, the purpose of the Feasibility Report is to identify the uses of natural gas and prioritize those applications from an economic perspective. This Feasibility Report addresses

- Current natural gas supply and demand situation focusing on northern Afghanistan
- Preconditions to expanded demand,
- Priority uses of natural gas ("NG"),
- A conceptual roadmap for the development of gas utilization, and
- Proposed institutional structure for an expanded gas market in Afghanistan.

This Feasibility Report identifies the economic drivers as well as the challenges in Afghanistan for the SGDP as well as other future relevant gas and power development projects to facilitate the revitalization of the natural gas industry. *This Report was created for the Afghan Government to begin an analysis of the possible economic behavior of the natural gas market demand. The Report only contains indicative data, extrapolations and inferences regarding the possible approaches for the development of the natural gas market in Afghanistan. There were many areas where economic data was unavailable or seemed to be inaccurate, so conservative assumptions or extrapolations were necessary to complete the economic review. For example, in the absence of real market data to indicate actual investment return expectations, the methodologies employed, such as the Capital Asset Pricing Model (CAPM), are simply a means of hypothesizing numbers to use for calculating other numbers, such as net wellhead prices. As such, the CAPM results are not intended to and do not create any reference point for business negotiations. The investment return expectations could be significantly higher or lower.*

After many years of civil conflict, the Afghan economy has found the path of economic development. One example is the high GDP growth in 2011, about 9.5%. The reconstruction phase has stimulated investment, for that reason the main growth sectors are construction, transport, telecommunications, energy and health. International financial assistance has worked as an economic engine to cause the

economic expansion, thus, the demand for products and services has increased. All sectors of the economy have participated in development and important economic progress has been accomplished. Although the Afghan economy was primarily based on agriculture, industry and services, the behavior of these areas as shown in the graphics below are not correlated. Also, importantly, the services sector (telecommunication, transport, education, health) has increased their participation while the agriculture sector has diminished on a comparable basis in the last 10 years. Nevertheless, the recovery of the last few years seems to be moderate to strong.

General Afghan Hydrocarbon Market Characteristics

The absence of significant internal hydrocarbon production, the high growth of hydrocarbon imports, some market restrictions, and low quality of imported oil are the main features of the Afghan hydrocarbon market today. Historically and currently there is very little domestic production of crude petroleum in Afghanistan. Some reserves of oil were discovered in the country in the late 1960s. In fact, an oil field, Angot in Sar-e-Pul, was developed, but oil production was intermittent, with daily outputs averaging 500 barrels per day or less. This field continues to produce small quantities of crude oil, but only primitive means are used to refine the oil produced at the field in Sar-e-Pul.

Geographic distribution of trade is broader relative to the 1960's and 1970's when the Soviet Union accounted for some 80% of Afghanistan's petroleum products imports. Today, due to liberalization of commerce, many countries are involved in this industry. Nearly all petroleum products are imported from neighboring countries, mainly Turkmenistan plus Uzbekistan, Russia and Kazakhstan. All transport of bulk imported supply is handled by road tanker since the short rail transport to Mazar ends there and road tanker is utilized after that. Fuel is imported into Afghanistan via Aquina, Torgundi and Hairatan in the north, Islam Qala and Zaranj in the west and Torkham and Spinboldak in the south and east.

Afghan Hydrocarbon Demand

Three issues influence hydrocarbons demand: residential (especially for cooking and heating, power generation), transportation and commercial/industrial uses. In Afghanistan, the demand for the three elements is growing, usually associated with rising GDP, despite the oil price increase. Residential and commercial/industrial demand is growing, in particular, in urban area.

Currently, diesel is used for civil and military transportation and for electricity production uses and we can observe that diesel demand is higher than gasoline. For the greater fuel efficiency, diesel vehicles are generally preferred over gasoline but many Afghan vehicles, including passenger cars, have gasoline engines. As shown in the report figures, following the major economic activity of the last few years, there was an increase in the number of the vehicle imports with a corresponding increase in oil derivatives imports.

Demand for transportation is most significantly affected by military demand. So the reduction of that demand is expected in the future with North Atlantic Treaty Organization ("NATO") troops' withdrawal and would lead to a notable decline in total demand. Demand variation depends on various factors, such as structure of the market, existence of substitute products, nature of product, etc. However, the main factor is the future evolution of GDP growth. If economic growth continues on the same path as in the past, the demand will increase. Otherwise, the demand will adjust, at least in the short term.

Several factors facilitated the recent liquid petroleum gas ("LPG") market growth, i.e. growth of demand;

growth of income; lack of other kinds of suitable energy; urbanization; increased use in transportation in areas with difficult access; simplicity of use; regulatory measures imposed on the commercial and light industries sector encouraging LPG use; and its relative cheaper price than wood for urban households.

Although demand for all hydrocarbon products is growing, growth of demand for LPG is moderate and less impacted by economics. That means this demand is more inelastic. In 2011-2012, the value of imports of hydrocarbons (petrol, diesel, LPG) was US$891 million. For imports of these three products, the share of diesel represents nearly 50%, followed by gasoline at 37%, and LPG at 13%. And in 2011-2012, Afghanistan has spent over US$ 2 billion for its energy imports. Accordingly, hydrocarbons represent 35% of the trade deficit.

Natural Gas Supplies in Afghanistan

From the late 1960's until the 1980's, NG production was an active and dynamic component of the Afghan economy. After their initial exploration work, with Soviet technical assistance, production started modestly during the1960's and increased, achieving its peak level at the end of 1970's. The decade of the 1980's was the beginning of the economic and political disturbances that seriously damaged the Afghan economy. The NG industry along with other sectors of the economy suffered dramatically. This negative impact had severe consequences on the Afghan economy since the NG industry was one of the most important sources of foreign exchange to finance Afghanistan's economic development.

Development of the NG industry was previously one of the priorities for Afghanistan, in fact, NG was included in the second plan in 1957 in order to support economic growth of the country and create an economic center for development. The NG production in 1979 was over ten times higher than at the beginning level of exploitation, as shown in the report figures.

Many exploration missions were conducted and the production started modestly in the 1960's before reaching its peak in the 1970's. Today, the total production comes from the northern regions, principally Sheberghan, the capital of Jowzjan. There are about 24 active NG wells in the Sheberghan area and the gas supply was to the residential and commercial sector in Sheberghan and to Kod-e-Barq-e Mazar-e-Sharif by pipelines that moves the gas from the producing areas.

Although the reserves of NG in the proven and probable categories are substantial, the current production of NG represents only 5% of that of 1970's. For the 2011-2012 period, total reported NG production was 160.354 MMCM, a small increase of 11% from the 2010-2011 levels, but this is due to a single rehabilitated well and not driven by sustained institutional measures.

Natural Gas Demand in Afghanistan

The nature and level of the demand for goods and services are based on several factors including population growth, the number of people per household, the preferences of population for different forms of energy, the national priorities in terms of development of certain industries or economic sectors, and the penetration of new technologies or forms of energy in the market.

The internal Afghan demand for NG was and still is limited. From the beginning, demand from the former USSR and from the domestic industrial sector supported the Afghan NG industry. While the delivery of the gas to residential and commercial sectors was a third component, a majority share of NG was exported due to economic and political considerations to the former Soviet Union, who bought substantial NG at low prices. While the planned objective was not reached, the exports of NG were a

key favorable component of the trade balance, without which the trade balance would have been more negative.

Afghan Gas Enterprise Involvement

Production, transmission, distribution and price policy of NG are the responsibility of the State Owned Enterprise, Afghan Gas Enterprise (AGE) under the Ministry of Mines. According to information supplied by AGE, the current NG cost price is low on a regional basis, because, among other things, it is limited by the low cost of production and transportation as well as the regulated price. In fact, most of the infrastructure for the NG is old and in poor condition. Although the salary levels at AGE are low, salaries and contractor costs still account for 67% of the gas price.

Natural Gas Pricing

AGE charges different prices for the residential, commercial and industrial sectors and these prices were relatively flat for many years. The average AGE's sales price in 1391 (2012-2013) is 1.74 AFN per cubic meter (US$34/MCM).

Those prices are very low in comparison to an approach using commercially viable and sustainable estimates in a preliminary Economic Model created by SGGA for gas to power analysis. Assuming an IRR of 17% for the power plant and 20% for the investment in the drilling and processing plant, a US$120/MCM price for the NG used in the generation of electricity was calculated. This US$120/MCM price level is almost 4 times the prevailing sales price.

Factors Impacting Future Natural Gas Pricing

The sources of energy that can be replaced by the increased availability of NG in Afghanistan include: 1) coal used in main industries; 2) LPG used in small food processing industries; 3) LPG used by families (households) especially for cooking purposes; and 4) gasoline used by cars (vehicles) as fuel. The Table 1 below presents the price of gasoline, coal and LPG in Afghanistan during the first semester of 2013, in local currency (AFN) and in US$.

Table 1: Current Energy Prices

Product	Unit	Price (AFN)	Price (US$)
Gasoline	Liter	50.0000	0.9091
Coal	Kg.	10.0000	0.1818
LPG	Kg.	54.0000	0.9818

The Table 2 presents the prices of the same three product but in equivalent terms for NG and expressed in US$/MCM. Also, Table 2 presents the proposed, final consumer price for NG price relative to the product that will be substituted. That is, if the NG has to replace gasoline then maximum consumer price of NG has to be US$636/MCM; in the case of coal is US$182/MCM; and to replace LPG is US$517/MCM. These NG prices represent sufficient discount levels to induce consumers to switch fuels as well as to counter competitive price responses by those alternate fuel suppliers. Also it is very important to note that most of the NG volumes will replace coal use by commercial and industrial consumers. Domestic coal prices are currently selling below the export market prices and that low domestic market price creates a low ceiling price against which the NG must compete.

Table 2: NG Equivalent Energy Prices and Proposed NG Prices

Product to be replace	Unit	Max. Consumer Price (US$)	Proposed Consumer Price (US$)
Gasoline	MCM	909	636
Coal	MCM	260	182
LPG	MCM	739	517

Following previous studies about the development of NG market in Afghanistan, this report will evaluate the conditions in the urban areas of the following regions: 1) Balk (Mazar-e-Sharif); 2) Jowzjan (Sheberghan); 3) Samangan; 4) Baghlan; 5) Kunduz; 6) Parwan (Charikar) and; 7) Kabul. Since there's already a pipeline between Sheberghan and Mazar-e-Sharif, this Report considers four scenarios:

1) Low Case: this scenario consists of supplying NG to Sheberghan and Mazar - E - Sharif and the installation of a Power Plant of 200 MW in Sheberghan, very close to the gas fields,
2) Case 1: in this scenario a pipeline for the supply of NG will extend from Sheberghan to Kabul and to Kunduz at a rough order of magnitude capital cost estimate of US$800 million, with one Power Plant in Sheberghan of 200 MWs and another Power Plant in Kabul of 200 MWs;
3) Case 2: in this scenario a pipeline for the supply of NG will extend from Sheberghan to Kabul and to Kunduz at a capital cost (from #2 above) of US$800 million, with one Power Plant in Sheberghan of 200 MWs and another Power Plant in Kabul of 400 MWs;
4) Case 3: in this scenario a pipeline for the supply of NG will extend from Sheberghan to Kabul and to Kunduz at a capital cost (from #2 above) of US$800 million, and includes Power Plants only in Sheberghan of 600 MWs.

The following Table 3 presents the prices in each one of the scenarios considered in the Feasibility Report.

Table 3: Projected Transport Tariffs and Wellhead Prices

Scenarios	Project	Competitive Price (US$/MCM)	Distribution: Opex+Capex +Tax+Profit (US$/MCM)	Price City Gate (US$/MCM)	Transport: Opex+Capex +Tax+Profit (US$/MCM)	Wellhead Price (US$/MCM)
Low Case	Distribution North	181.8	46.9	135.0	41.1	93.9
	PP 200 MW Sheberghan	120.0	-	-	-	120.0
	Fertilizer Plant	34.8	-	-	-	34.8
Case 1	PP 200 MW Sheberghan	120.0	-	-	-	120.0
	Distribution North - Kabul	182.8	34.7	148.1	48.4	99.7
	PP 200 MW Kabul	120.0	-	-	48.4	71.6
	Fertilizer Plant	34.8	-	-	-	34.8
Case 2	PP 200 MW Sheberghan	120.0	-	-	-	120.0
	Distribution North - Kabul	182.8	34.7	148.1	42.5	105.6
	PP 400 MW Kabul	120.0	-	-	42.5	77.5
	Fertilizer Plant	34.8	-	-	-	34.8
Case 3	PP 600 MW Sheberghan	120.0	-	-	-	120.0
	Distribution North - Kabul	182.8	34.7	148.1	61.1	87.0
	Fertilizer Plant	34.8	-	-	-	34.8

In order to better understand these results, the following factors were assumed:

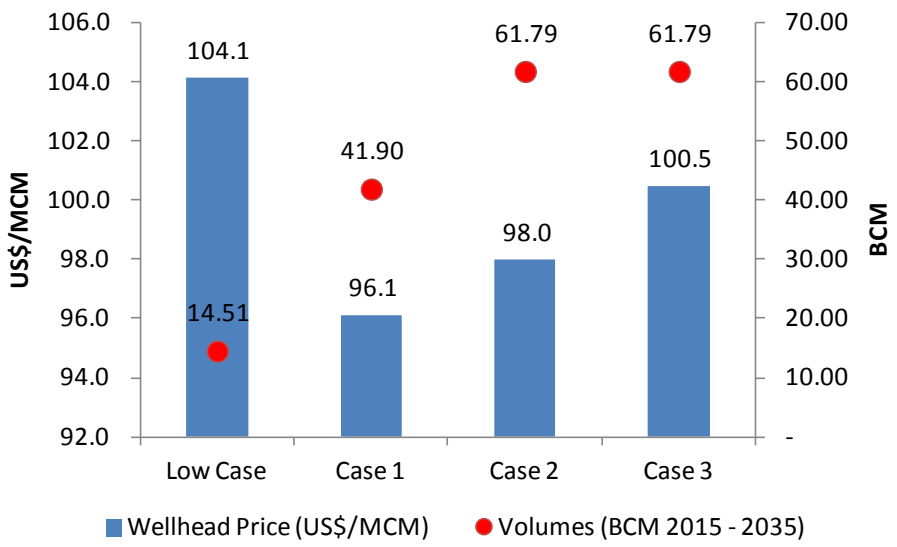
1) In the Low Case scenario the transport tariff could be very small, just enough to cover O&M expenses because the TFBSO would not expect a return on its donor investment. However, *it appears more appropriate to adopt a uniform or universal transportation tariff to support an*

expansion of the transmission system to supply NG to multiple cities for commercial viability and sustainability, including the largest Kabul, rather than favor the two cities that fortuitously were closer to the gas reserves with very low transport tariffs. Since Sheberghan and Mazar-e-Sharif have benefited from the existing reserves and pipeline at low costs while the rest of the country did not have NG, it seems reasonable that Sheberghan and Mazar-e-Sharif now bear some of the pricing burden of sharing NG with other parts of the country.
Also, in order to avoid rate shock from the additional costs to fund the future pipeline to Kabul, the Sheberghan and Mazar-e-Sharif consumers should begin paying the indicated transport tariff immediately. If the Kabul pipeline does not proceed, then the transportation tariffs can be reduced or refunded.

2) Since the fertilizer plant does benefit the entire country, it would be exempted from the transportation tariffs – no change from present status;
3) Similarly the new Sheberghan power plants (200 MW in Case 1 and 600 MW in Case 3) and in the Low Case would not pay the transport cost since the NG facilities supplying the power plants would not use the pipeline system and power may be widely used by the public, which will also pay the power transmission tariff;
4) In Cases 1, 2 and 3, the volumes for the LDCs (in all the Provinces considered in the Report) will pay the distribution margin and the transport cost;
5) The assumed power plant in Kabul (200 MW in case 1 and 400 MW in case 2) will pay the transport tariff since there is very substantial capital investment for gas transportation but the power is consumed in Kabul and those consumers do not pay much, if any, power transmission costs;
6) The competitive prices presented for the distribution sector (including industrial, CNG and residential demand) are the weighted prices for each distribution system; and
7) The Wellhead Prices presented are the weighted average of the demand by the all sectors.

The results for well head prices and cumulative volume (for the period 2015 - 2035) are summarized in the following chart for each scenario.

Table 4: Cumulative Gas Sales and Wellhead Prices



Some observations can be made about these results:

1) The Low Case offers the highest wellhead price but on substantially lower volumes;
2) Case 1 presents the lowest price and volumes (relative to Cases 2 and 3) because it only considers a 200 MW additional plant in Kabul, so the wellhead price is lower because the transport costs are higher; and

3) Cases 2 and 3 present the highest and equal volumes (there's a 600 MW generation in both alternatives) but in Case 3 the wellhead price is higher because the NG volumes used in Sheberghan to generate the additional 600 MW doesn't pay any transport cost.

Wellhead Prices

After analyzing all the statistics, one of the main conclusions of the study is that the energy market for the country is open with relatively low prices. That is, in the short term, the internal market is the fast and relatively simple way to develop the NG reserves, nevertheless, the price of alternatives sources of energy and the cost to develop infrastructure to supply NG the industrial, commercial, CNG, residential and power generation is high. For that reason, an expected wellhead price around US$100 – $130/MCM, appears reasonable and commercially viable for a developing country like Afghanistan. The low cost of the coal sold in the country puts a ceiling on the NG prices since a substantial portion of the industrial energy matrix relies upon coal.

Exports

Exporting NG via a pipeline to Pakistan and India offers some higher wellhead prices but first additional reserves must be verified, political issues resolved, and billions of investment dollars raised, likely requiring donor funding.

Roadmap

The development roadmap to facilitate this work includes the following steps:

1) Establish the appropriate MoMP structure(s) and institutional capability;
2) Successfully complete the SGDP and the new Yatimtaq and Gerquduq gas field re-development projects;
3) Implement the GIRoA policy for energy security through domestic generation using NG;
4) Design supportive NG pricing for each energy market end-user segment;
5) Identify and Mobilize Stakeholders;
6) Identify the projects within market segments that meet the high GIRoA priorities and are commercial viable and sustainable;
7) For each high priority project ensure
    a. Private enterprises can implement their part;
    b. Any needed donors are identified and committed;
8) Ensure economic interests of all parties are aligned for sustainability; and
9) Implement.

Proposed Institutional Structure

It is preferable for the MoMP to re-align policy, commercial, and regulatory functions in keeping with the overall policy of the Ministry and the Government.

The separation of commercial functions has been initiated recently by a request to the Cabinet to authorize the conversion of Afghan Gas Enterprise (“AGE”) into a State-owned commercial corporation, tentatively named the Afghan Petroleum Corporation (“APC”). That process should be continued in a manner to produce an entity with the all licenses, operating, and production rights, appropriate assets, qualified staff, and operational latitude to be successful.

The MoMP should consider establishing a separate division or department within the Ministry to regulate the technical, safety, and environmental aspects of oil and gas operations, including exploration, production, transportation, gas processing, and oil refining. Such regulatory authority

should cover health, safety, and environmental standard-setting and compliance, both statutory and contractual. Ideally, this should include full authority over all hydrocarbon activities. Full inclusion might require reaching agreements with other governmental with overlapping jurisdiction agencies (e.g., NEPA) to delegate sectorial responsibility to the Ministry, or new legislation assigning exclusive jurisdiction to the Ministry.

The MoMP should exercise its core sovereign functions of tendering and awarding hydrocarbon contracts, managing the commercial aspects of such hydrocarbon contracts, promoting the development of the Afghan hydrocarbon industry, and developing and implementing national hydrocarbon policy. These core functions will almost certainly include:

- Establishing and implementing long-term State hydrocarbon policy
- Setting terms for and issuing hydrocarbon exploration, production and transportation contracts
- Managing the State's interest in exploration and development contracts, to the extent such functions are not delegated to APC
- Regulating hydrocarbon production for economic purposes, such as price stability (as opposed to setting technical, conservation-based production rates, which should remain a regulatory function)
- Overseeing the operations of the State-owned hydrocarbon companies, such as APC, through their governing bodies, as provided by law or the company charters and statutes.
- Collecting and maintaining geological, geophysical, and production data, probably at the Afghan Geological Survey.
- Promoting development of the Afghan hydrocarbon industry and Afghan hydrocarbon policy internationally.

2 Background

This "*Final Feasibility Report on Industrial Development and Natural Gas Market Development in Afghanistan*" ("Feasibility Report") is part of USAID's Technical Assistance for a gas development program and a 200-MW power plant in Sheberghan, Afghanistan, which is being performed by the Sheberghan Gas Generation Activity ("SGGA") in 2012 through 2014. This work is part of USAID's Technical Assistance to Afghanistan's Ministry of Mines and Petroleum ("MoMP"), Task Order No. AID-306-TO-12-00002 ("Task Order").

SGGA's scope of work focuses on the support of projects and transactions relevant to the Sheberghan Gas Development Program ("SGDP"). The scope of this task order consists of design and implementation of a capacity enhancement program for the commercialization and modernization, and possibly corporatization, of Afghan Gas Enterprise. It further consists of a program to promote sustainability of the projects completed within the SGDP through training and mentoring of the MoMP and other relevant GIRoA institutions such as DABS and MEW, as mutually agreed to by GIRoA and USAID. This training, mentoring and capacity enhancement program will also provide the basis for the production of a comprehensive feasibility report on industrial development and effective utilization of Afghanistan's hydrocarbon reserves, including, but not limited to, the Sheberghan gas fields in Jowzjan Province in Northern Afghanistan and the creation of a natural gas market in Afghanistan.

2.1 Feasibility Report Framework

The framework of the Feasibility Report follows the structure in the Task Order, which is set forth below, but also adds some key elements for better appreciation by the reader:

1) Definition and analysis of the current natural gas supply and demand situation focusing on northern Afghanistan, except when/where bottled gas products ("CNG") are involved. The report must identify:
   a) Size of supply and demand
   b) Unmet demand
   c) Market segmentation
   d) Constraints within the current market
   e) Transportation
   f) Pricing
2) Preconditions to expanded demand, such as:
   a) Competitive gas pricing
   b) Gas transportation systems [pipelines, bottled gas, etc.]
3) Priority uses of natural gas based on value added and overall economic benefit, ranking at a minimum the following end uses:
   a) Fertilizer production
   b) Power generation
   c) Commercial uses (e.g. glass and glassware production, ceramics, brick making, and other large scale industrial production processes, transportation fuel [CNG])
   d) Residential use (cooking and heating)
   e) Gas exports
   f) LNG
4) Conceptual roadmap for the development of gas utilization, including those uses listed above
5) Proposed institutional structure for an expanded gas market in Afghanistan with appropriate roles of GIRoA and the private sector defined.

In order to more fully appreciate the results provided from the framework, the Feasibility Report includes some additional key elements to provide more contexts for better understanding. The additional key elements include:

- Brief Afghan energy history;
- A Regional NG Markets Perspective;
- An overview of the Afghan Economy and Industrial Development; and
- A summary of the hydrocarbons sector in Afghanistan

With the perspective from these key elements in mind, the framework results can be better appreciated.

2.2 Brief Afghan Energy History

Substantial proven reserves of NG exist near the town of Sheberghan in northern Afghanistan. NG has been extracted since the 1960's, but the current daily production rate of about 437MCM/day is only about 5% of the peak historical level. Years of war and neglect have left Afghanistan's economy in poor condition, particularly the energy sector. In the past, Afghanistan was a prolific energy exporter, but today the country imports almost 70% of its energy needs, so development of NG reserves would be very beneficial. Development will require simultaneous efforts in upstream field development and downstream market creation.

Regarding electricity, prior to 1978, Afghanistan was able to access to approximately 396 megawatts ("MW") of domestic power generation compared to approximately 243 MW of power in 2002, at which time almost 50% came from domestic hydropower. In 2004, the Ministry of Energy and Water ("MEW") identified expanded power imports as a key medium-term strategy to address the unmet demand within Afghanistan. The summer operating capacity of Afghanistan grew to approximately 750 MW of power

by 2007. In that year about one third (33%) of electrical power delivered to the grid was imported from neighboring countries. Recent improvements in energy transmission and distribution systems have facilitated a significant increase in the amount of imported power, which accounted for 70% of total power supply in 2010. Importantly, while NG is a prime fuel source for power generation in many countries, Afghanistan only has one small NG fueled power plant producing less than 20 MWs, associated with the Northern Fertilizer plant.

Article Nine of the Afghan constitution identifies the government of Afghanistan as the owner of the mineral rights and other natural resources. The Ministry of Mines and Petroleum ("MoMP") is the key sectorial ministry responsible for research, exploration, development, exploitation, and processing of minerals and hydrocarbons. The MoMP is endeavoring to create an effective administration to promote the efficient utilization of natural resources, local job opportunities, and the mobilization of private investment in the mining and hydrocarbon sectors.

The MoMP has stated the following as its Mission and Vision, which aligns with the efforts involving the Sheberghan Gas Development Project (SGDP).

> "*The Ministry of Mines has a mandate to deliver on the Government's vision for sustainable, market-based, economically successful minerals and hydrocarbons sectors that encourages and protects private capital investments and enterprises as set out in the Constitution of Afghanistan and the Afghan National Development Strategy (ANDS). To achieve this, the Government is committed to establishing Afghanistan as an attractive destination for private sector investment in the exploration and development of mineral and hydrocarbon resources.'*

In this context, the Ministry of Mines' vision, mission and strategy are defined in the following way:

> *Vision: To be the leading economic ministry in the Government of Afghanistan, supporting national and local economic development and ensuring optimum revenues for Afghanistan from its mineral resources in a responsible manner.*
>
> *Mission: To be an enabler of the mining sector's development and steward of all mineral, hydrocarbon and ground water resources through the implementation of international best practice policies, regulations and procedures to encourage environmentally and socially acceptable private investment."*

The Ministry of Mines' vision, mission and strategy is supportive of the appropriate means of developing its natural gas reserves and facilitating the economic development in Afghanistan.

The Afghanistan Compact developed at the London Conference in Jan-Feb 2006 defined energy benchmarks for Afghanistan. "Energy, abundantly and cost effectively supplied, is an important input in the sustainable development of Afghanistan. It is a necessary but not sufficient condition for economic growth. Energy provided cost effectively in sufficient quantity and quality on a sustainable basis will support economic development and employment; help reduce poverty; contribute to social and political stability both within Afghanistan and regionally; improve living standards; and contribute to a reduction in environmental impacts."

The MEW has stated its goals and policies include the following.

Goals

- *Development of indigenous resources for power and energy use*

- *Reduced Poverty: Provide essential energy supply services that will help private sector development, job creation and poverty reduction.*
- *Reduce health and environmental costs associated with energy supply and uses.*

Policies

- *Recognize the priority of electricity supply projects and develop the mechanism to ensure coordination among the other Government entities as required, sharing of data by these institutions, and capacity building programs.*
- *Adopt in policy and embody in law, the principle of private sector provision of energy.*
- *Establish guidelines for energy efficiency, cost recovery, environmental issues.*
- *Establish procedures to ensure effective coordination among the different sector Government entities*

Therefore, the development of the Sheberghan and other gas fields and related infrastructure, including increased electricity generation and transmission, is a shared objective of the USG and relevant GIRoA ministries. To support this objective, the SGGA produced this deliverable, *"Final Feasibility Report on Industrial Development and Natural Gas Market Development in Afghanistan (*"Feasibility Report"*)."* The goal of the Feasibility Report is to review the existing Industrial Development at a high level, the potential application of natural gas domestically and for export, and consider the conceptual roadmap for the development of gas utilization together with a proposed institutional structure for implementation.

Before looking at the Afghanistan gas sector in detail, it is helpful to create a context, so the following sections will initially review the gas sector situation in relevant Central and South Asian region countries. Thereafter, there is an examination of the Afghan economy and the impact of a NG substitute, petroleum, on the economy. Finally, the Afghan gas market is examined with the foregoing perspectives.

2.3 Regional NG Markets Perspective

In this section are presented some main features about the NG markets in countries of the region, in particular, China, India, Iran, Pakistan, Tajikistan, Turkmenistan and Uzbekistan. The main objective is providing a view of the net export/import situation of each country regarding the internal NG production and consumption. The main sources of data are the US Energy Information Administration and the British Petroleum Statistics.

2.3.1 Production

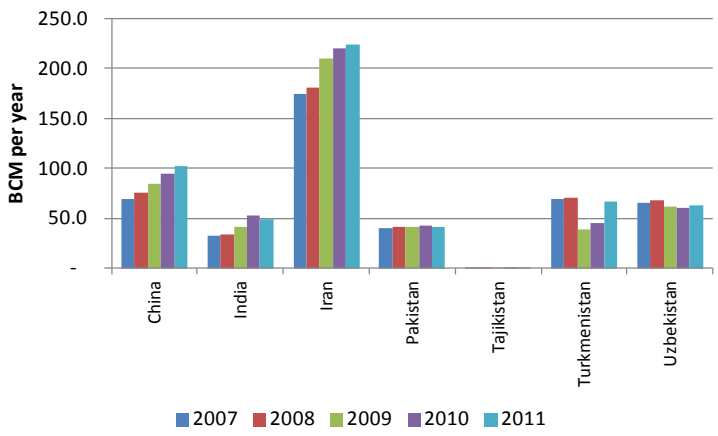
Table 5 presents the total production of the selected countries for 2007-2011, and Figure 1 shows the evolution of the production for each country. It's clear that Iran and China are the main producers, for example, in 2011 these countries reached a production of 641 MM CMD and 282 MM CMD, respectively, and those two countries also had high annual rates of growth, especially China. Also, it is important to note the decline in the production of gas by Turkmenistan during years 2009-2010, as a result of a pipeline explosion and a soured relationship with Russia and Gazprom that was subsequently corrected. Another country with high production and low growth is Pakistan; it can be observed that in this period that the production was stable in 115 MM CMD.

Table 5: Regional NG Production (BCM/year)

Country	2007	2008	2009	2010	2011	Annual Growth
China	69.3	76.0	84.2	94.4	102.8	10.4%
India	32.3	33.1	41.7	53.3	48.6	10.7%
Iran	174.2	180.4	210.3	220.1	224.1	6.5%
Pakistan	40.0	41.1	41.8	42.8	41.7	1.0%
Tajikistan	0.02	0.03	0.04	0.04	0.02	-1.3%
Turkmenistan	68.9	70.5	38.2	45.3	66.2	-1.0%
Uzbekistan	65.2	67.6	61.4	60.1	63.0	-0.8%

Source: US Energy Information Administration, BP

Figure 1: NG Production by Country (BCM/year)



2.3.2 Consumption

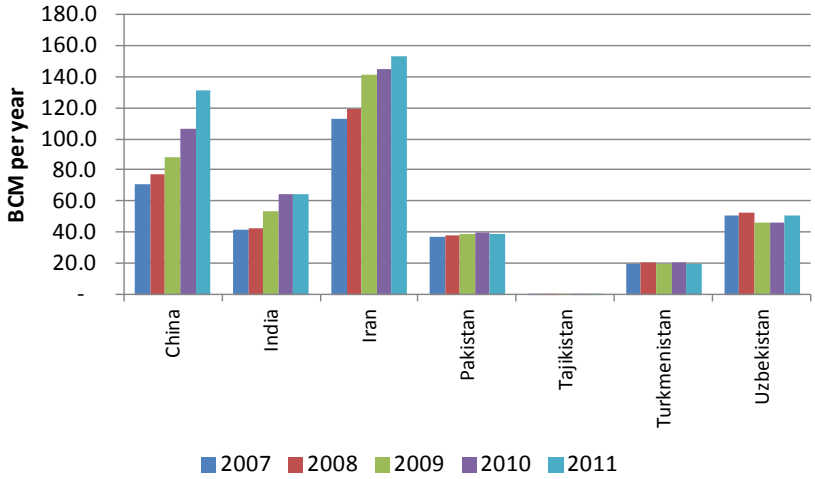
The consumption of NG in presented in Table 6 and Figure 2, as in the production analysis, the data are expressed in BCM per year. It's clear that for most of the countries the annual rate of growth of consumption is larger than the production growth. This situation is most obvious in the case of China, where in 2007 the consumption and production were very similar, but by 2011 the consumption was 30% higher than the total production, so the imports needs of this country were high, which is a situation also present in India. On the other hand, Pakistan seems to have limited the internal consumption due to some production restrictions. In the case of Turkmenistan, the increase in the production of 2011 didn't occur because of a larger internal demand, rather, it was due to improved relations with Russia and Gazprom for an increase in gas exports in that year.

Table 6: Regional NG Consumption (BCM/year)

Country	2007	2008	2009	2010	2011	Annual Growth
China	70.5	77.2	88.5	106.7	130.9	16.7%
India	41.4	42.9	53.3	64.5	64.0	11.5%
Iran	113.0	119.3	141.4	144.6	153.3	7.9%
Pakistan	36.8	38.0	38.7	39.6	39.2	1.6%
Tajikistan	0.7	0.4	0.2	0.2	0.2	-25.9%
Turkmenistan	19.5	21.0	20.1	20.4	20.1	0.8%
Uzbekistan	50.5	52.6	46.2	45.7	51.0	0.3%

Source: US Energy Information Administration, BP

Figure 2: NG Consumption by Country (BCM/year)



2.3.3 International Trade

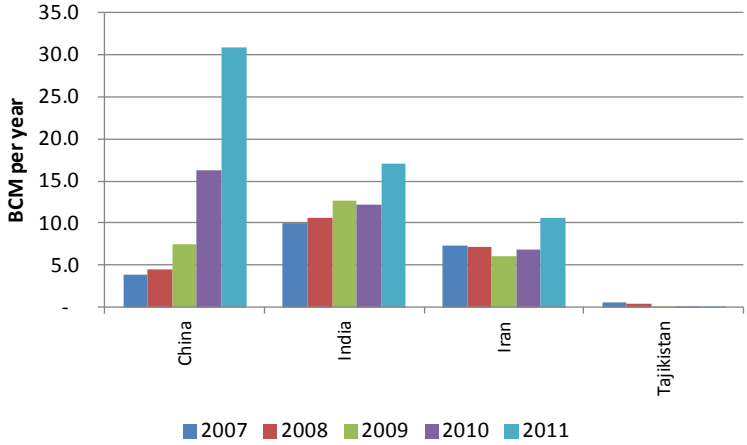
Regarding the importation of NG, Table 7 and Figure 3 present the behavior of the gas importing countries in the region: China, India, Iran and Tajikistan. It is evident that the internal needs of NG in China and India were solved with an increase of imports. In particular, China showed an average annual rate of growth equal to 67.5% based upon incremental increases of NG imports from 3.9 BCM in 2007 to 30.9 BCM in 2011. Almost 50% of these imports came from Turkmenistan (see Table 9) and the rest from LNG projects (Australia 29.8%, Qatar 19.1%, Indonesia 16.4%, Malaysia 12.8%, Yemen 6.6%, Nigeria 5.9% being the important sources). On the other hand, for India 100% of imports are from LNG projects (Qatar 76%, Nigeria 7.9%, Trinidad & Tobago 3.3%, USA 2.5%, plus others). Finally, the 96% of the imports of Iran are from Turkmenistan and the rest from Azerbaijan and these imports could decline or stop in the future. Iran announced plans to build a pipeline to increase NG supplies to its northern provinces and cut reliance on imports from Turkmenistan. Iran has the second highest gas reserves in the world but must import gas to supply the Mazandaran province, bordering the Caspian Sea. Iran plans to complete a 160-kilometer (99-mile) link, which will carry gas from its Semnan province to Mazandaran province, in two years.

Table 7: Regional NG Imports (BCM/year)

Country	2007	2008	2009	2010	2011	Annual Growth
China	3.9	4.5	7.5	16.3	30.9	67.5%
India	10.0	10.7	12.6	12.2	17.1	14.4%
Iran	7.3	7.1	6.1	6.9	10.6	9.7%
Tajikistan	0.6	0.4	0.2	0.2	0.2	-27.2%

Source: US Energy Information Administration, BP

Figure 3: NG Imports by Country (BCM/year)



Regarding exports, Table 8 and Figure 4 present the main exporting results for countries in the region. It's clear that the access to the Russian and Chinese markets increased the Turkmen exports from 6.2 BCM in 2007 to 34.6 BCM by 2011 (Figure 5) converting Turkmenistan in a major NG exporting country in the region. In the second place in 2011 we found Iran and Uzbekistan with a similar export volume (9 BCM per year) but different pathways. Iranian exports increased from 6.2 in 2007 to 9.1 in 2011 (due to the strong market in Turkey) while the exports of Uzbekistan declined by over 37% in the same period, since the main market for this country's gas is Russia, see Table 9, and its exports were apparently displaced by Turkmenistan's increased exports to Russia.

One noteworthy development is the recent signing of an agreement between Iran and Pakistan for the import of NG into Pakistan. According to a December 2012 Financial Times report, Pakistan currently needs 8 Billion cubic feet a day ("BCFD") of gas, but was producing only 4.2 BCFD and had no facilities to import liquefied natural gas. In March 2013, Iran and Pakistan signed a gas sales and transport agreement for 20 years with a possible five-year extension. The agreement would support the export of 21.5 MMCM of Iranian natural gas to Pakistan on a daily basis, later rising to 30 MMCM per day. However, these Iranian imports would address less than 30% of the 3.8 BCFD (107.6 MMCMD) deficit and create an export market of 77 MMCMD for other pipeline or LNG projects.

Table 8: Regional NG Exports (BCM/year)

Country	2007	2008	2009	2010	2011	Annual Growth
China	2.7	3.4	3.2	4.0	3.1	3.2%
Iran	6.2	4.1	5.9	8.4	9.1	10.1%
Turkmenistan	6.1	6.5	16.7	19.7	34.6	54.3%
Uzbekistan	14.7	15.0	15.7	13.6	9.2	-11.1%

Source: US Energy Information Administration, BP

Figure 4: NG Exports by Country (BCM/year)

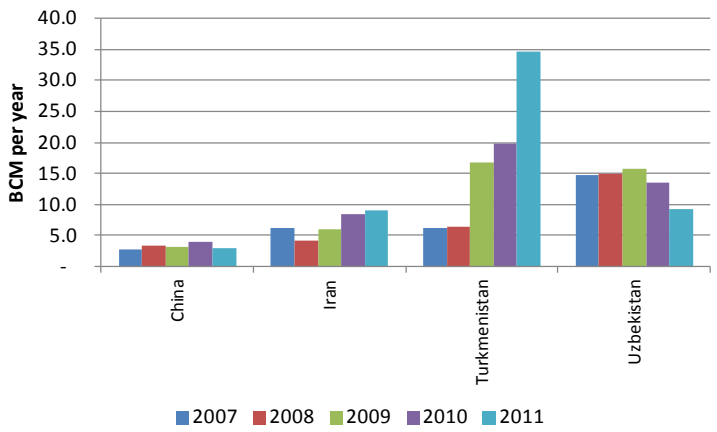
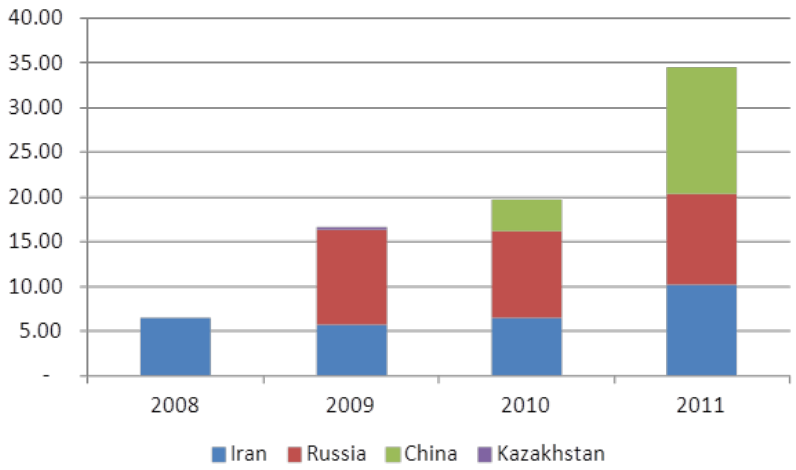


Table 9: Regional NG Imports and Exports 2011 (BCM/year)

Country	China		India		Iran		Tajikistan		Turkmenistan		Uzbekistan	
	Imports from	Exports to	Imports from	Exports to	Imports from	Exports to	Imports from	Exports to	Imports from	Exports to	Imports from	Exports to
Armenia	-	-	-	-	-	0.5	-	-	-	-	-	-
Azerbaijan	-	-	-	-	0.4	0.3	-	-	-	-	-	-
China	-	-	-	-	-	-	-	-	-	14.3	-	-
Hong Kong	-	3.1	-	-	-	-	-	-	-	-	-	-
Iran	-	-	-	-	-	-	-	-	-	10.2	-	-
Kazakhstan	-	-	-	-	-	-	-	-	-	-	-	1.7
Kyrgyzstan	-	-	-	-	-	-	-	-	-	-	-	0.2
LNG	16.6	-	17.1	-	-	-	-	-	-	-	-	-
Russia	-	-	-	-	-	-	-	-	-	10.1	-	7.1
Tajikistan	-	-	-	-	-	-	-	-	-	-	-	0.2
Turkey	-	-	-	-	-	8.4	-	-	-	-	-	-
Turkmenistan	14.3	-	-	-	10.2	-	-	-	-	-	-	-
Uzbekistan	-	-	-	-	-	-	0.2	-	-	-	-	-
Total	**30.9**	**3.1**	**17.1**	**-**	**10.6**	**9.1**	**0.2**	**-**	**-**	**34.6**	**-**	**9.2**

Source: BP

Figure 5: Turkmenistan NG Exports (BCM/year)



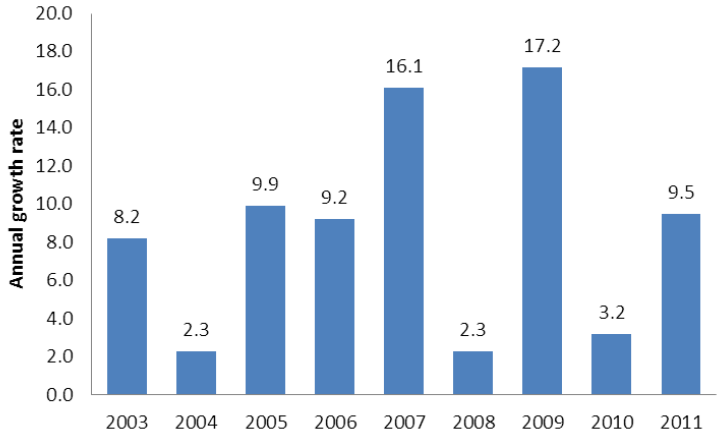
2.3.4 Afghan Economy and Industrial Development

After many years of civil conflict, the Afghan economy has found a path of economic development. One example is the good GDP growth over the last 9 years ending in 2011, about 8.65% as shown in Figure 6. Importantly, such growth is from a very low level, starting at a GDP of US$207 per person in 2003 reaching US$715 (based on a 26.5 million population) in 2011 according to Central Statistics

Organization of Afghanistan ("CSO"). Those 2011 numbers from the World Bank, IMF and other sources show a population closer to 30 million and roughly $1,000 GDP per person on a Purchasing Power Parity ("PPP") basis to address for the relative cost of living. Regardless of the choice of nominal or PPP numbers, the numbers place the country in the bottom 10% of all national economies in the world.

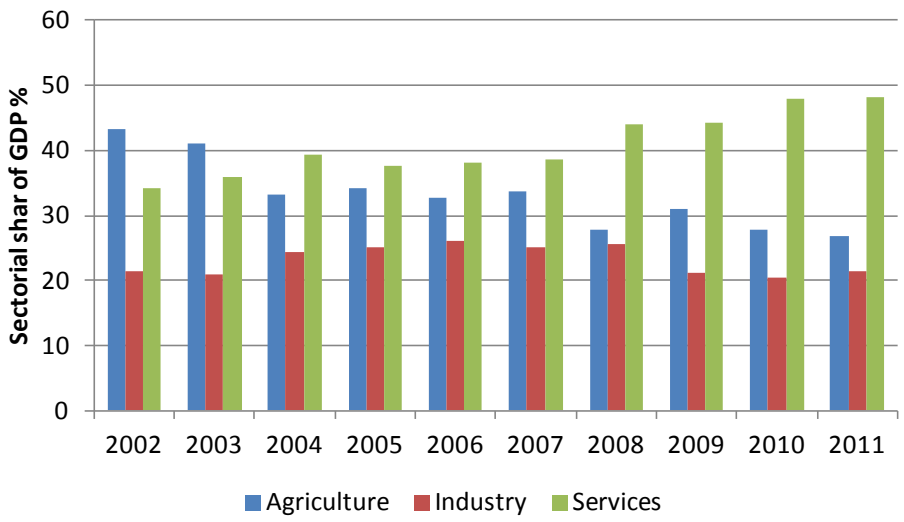
The reconstruction phase has stimulated investment with the main growth sectors being construction, transport, telecommunications, energy and health. International financial assistance has worked as an economic engine to cause the economic expansion, thus, the demand for products and services has increased.

Figure 6: Afghan Annual Rate of Growth



All sectors of the economy have participated in development and important economic progress. The Afghan economy was primarily based on agriculture, industry and services, however, the behavior of these areas as shown in the graphics below, Figure 7, are not correlated. Also, importantly, the services sector (telecommunication, transport, education, health) has increased their participation while the agriculture sector has diminished on a comparable basis in the last 10 years.

Figure 7: Important Sectors in Afghan Economy



The recovery of the last few years seems to be moderate to strong, as the World Bank pointed out in the Afghanistan Economic Update of October 2011:

"Afghanistan's economy is growing strongly. The growth drivers in recent years have been above average agricultural production, strong growth in construction and transportation, and security expenditure enabled by large aid flows, especially in FY2009/10. Real GDP growth reached 8.4 percent in FY2010/11."

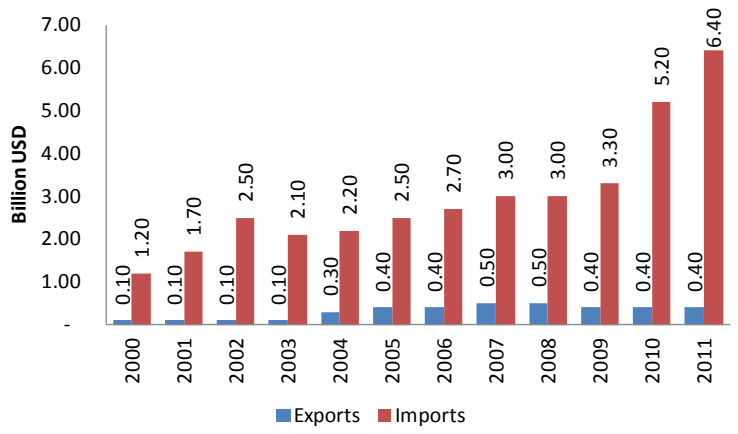
"Afghanistan's fiscal position is strengthening. In the last three years revenues grew by an average of 34 percent p.a., thanks to improvements in customs and tax administration. Larger increases are expected once mining operations begin in Aynak and Hajigak and with the introduction of a value-added tax in FY2014/15. However, government expenditures will also increase in the coming years due to higher security expenditure, the roll out of pay-and-grading reforms for the civil service, rising recurrent obligations from large donor-supported projects (including those financed outside of the core budget) and the fiscal costs of the Kabul Bank bailout."

"The country moved from sharp deflation to double-digit inflation in one year. The strong inflation trend is mainly explained by an increase for prices in food, electricity and fuels and reflects international price trends, disruptions in trade flows with Iran and Pakistan over the past year as well as a bad harvest in the 2Q, 2011 which limits the possibilities for food import substitution by households."

"Medium-term prospects are moderately good and will depend on the Government's ability to successfully manage the transfer of security control from international to national forces, and ensure political stability and fiscal sustainability. Long-term growth prospects will depend on the extent to which mining can be used to foster development in agriculture and services, which are crucial to food security, employment and poverty-reduction, and export revenue."

The Afghan economy is characterized by its high degree of imports. The import growth rate is much higher than the growth rate of exports. The weakness of production structure is the main factor, which is obvious from deficit balance in 2011 of around US$ 6.4 billion. As shown in the following Figure 8, the imports are much higher than the exports, with a substantial increase in the last two years, 2010 and 2011.

Figure 8: Imports and Exports in the Afghan Economy



A brief overview of the Afghan economy can be found in the following Table 10, where the following observations can be made: a) there was a great increase in the GDP per capita; b) there was a high dependency of the imports; c) there was a high impact of the oil imports within the total imports, for

example, in year 2011 it was 32.9%;[1] d) the increase in the imports (mainly oil) generated an increase in the deficit of the international account balance; and e) the export sector growth was modest.

Table 10: Key Indicators of the Afghan Economy

Concept	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
GDP Growth	%	N/A	N/A	N/A	8.2	2.3	9.9	9.2	16.1	2.3	17.2	3.2	9.5
GDP	MM USD	N/A	N/A	4,523.0	4,917.0	5,619.0	6,633.0	7,533.0	10,431.0	10,641.0	12,871.0	16,343.0	18,952.0
GDP per capita	USD	N/A	N/A	207.0	221.0	242.0	281.0	313.0	426.0	426.0	505.0	629.0	715.0
Population	Million	N/A	N/A	21.8	22.2	23.2	23.6	24.1	24.5	25.0	25.5	26.0	26.5
Exports	MM USD	137.0	68.0	100.0	144.0	305.0	384.0	416.0	454.0	545.0	403.0	388.0	376.0
Imports	MM USD	1,176.0	1,696.0	2,452.0	2,101.0	2,177.0	2,471.0	2,744.0	3,022.0	3,020.0	3,336.0	5,154.0	6,390.0
Deficit/Surplus	MM USD	(1,039.0)	(1,628.0)	(2,352.0)	(1,957.0)	(1,872.0)	(2,087.0)	(2,328.0)	(2,568.0)	(2,475.0)	(2,933.0)	(4,766.0)	(6,014.0)
Exports	% GDP	N/A	N/A	2.2	2.9	5.4	5.8	5.5	4.4	5.1	3.1	2.4	2.0
Imports	% GDP	N/A	N/A	54.2	42.7	38.7	37.3	36.4	29.0	28.4	25.9	31.5	33.7
Oil imports	MM USD	N/A	N/A	14.3	41.2	14.6	90.6	83.4	142.0	547.0	740.0	999.0	2,103.0
Oil imports	% Deficit of trad balance			0.6	2.1	0.8	4.3	3.6	5.5	22.1	25.2	21.0	35.0
Oil imports	% Total Imports	N/A	N/A	0.6	2.0	0.7	3.7	3.0	4.7	18.1	22.2	19.4	32.9

Source: Central Statistics Organization

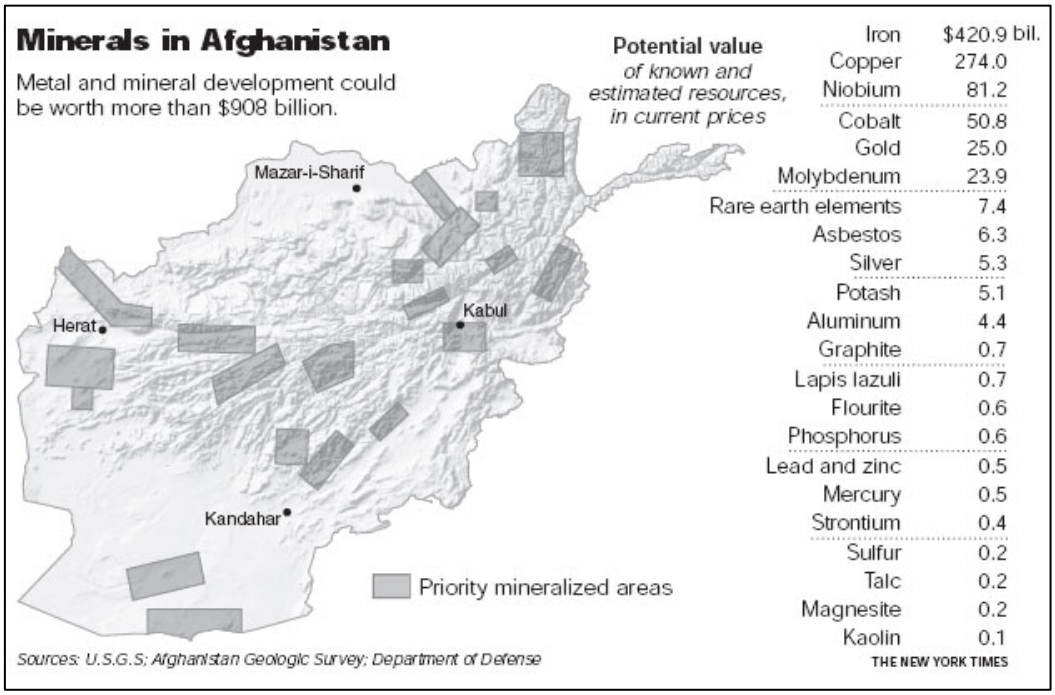
The primary factors holding back the economic growth of the country include the continuing civil unrest (which may worsen with the planned departure of most foreign military personnel in 2014), the lack of foreign investment due in significant part to the perception of corruption (Afghanistan is tied for last place among 176 countries evaluated according to the Corruption Perceptions Index 2012 by Transparency International), poor infrastructure, and inadequate, affordable electricity.

Industrial Development Opportunities

The most obvious areas for industrial development are mining and perhaps hydrocarbons. Based upon data previously collected by Soviet mining experts during the Soviet occupation of Afghanistan, the United States Geological Survey conducted advanced aerial surveys in 2006 and again in 2007. Figure 9 shows the locations and potential values of the Afghan metal and mineral ores The surveys revealed the biggest deposits were iron and copper with quantities sufficient to make Afghanistan a major world producer of both. Results also included large deposits of niobium, a soft metal used in producing superconducting steel, rare earth elements and large gold deposits in southern Afghanistan. Unfortunately, progress remains at a standstill with no major international mining company willing to invest yet in Afghanistan, likely due to the civil unrest and perceived corruption as well as inadequate power for ore processing plus inadequate or non-existent transportation infrastructure to export the ore.

[1] One explanation can be found in the increase of the international oil prices observed in the last years.

Figure 9: Locations and Values of Metal and Mineral Ores



Economic growth can have a calming effect on civil unrest if there is a belief that individuals' situations could improve, however, the corruption concern will continue to have a chilling effect on foreign investment until there is a noticeable improvement. Afghanistan's progress with its Extractive Industries Transparency Initiative could help address both issues. The ready availability of natural gas could also help address the inadequate, affordable electricity issue for mining.

The nature and extent of other existing industries that could be supported or developed begins with an examination of the current industries within Afghanistan and their energy matrix. The following chart, Figure 10, shows the relative size of the industrial sector. It is noteworthy that the largest manufacturing sectors are Food, beverage & tobacco at almost 12.5% and Construction at 7.21%, or US$2.25 Billion and US$1.3 Billion, respectively. The construction figure is not just the utilization of building materials and service to erect road and other civil infrastructure, offices, warehouses and houses but also includes the creation of building materials, such as brick making. By comparison, currently the other manufacturing areas are less that 1% of the GDP while mining and quarrying is just 1.15% of GDP despite the tremendous mining potential.

The Services sector represents 48.27% of the GDP with the largest segment at over 15% being Transport & Storage with US$2.7 Billion in 2011. This figure is somewhat misleading because it includes fuels for transportation, which in turn creates the significant potential for CNG as a transportation fuel.

Figure 10: Afghan Industrial GDP

Industrial GDP in current price (Million afs)

	2009	% of GDP	2010	% of GDP	2011	% of GDP	2011 US$
GDP at Market price	632,715.00		746,855.00		903,990.00		18,079.80
Industry	133,942.00	21.17	153,608.00	20.57	193,371.00	**21.39**	3,867.42
Mining and quarrying	2,921.00	0.46	4,473.00	0.60	10,396.00	1.15	207.92
Manufacturing	80,437.00	12.71	90,943.00	12.18	117,171.00	12.96	2,343.42
Food, beverage & tobacco	76,949.00	12.16	86,789.00	11.62	112,684.00	12.47	2,253.68
Textile, wearing apparel & leather	513.00	0.08	779.00	0.10	704.00	0.08	14.08
Wood & wood production including furniture	139.00	0.02	140.00	0.02	142.00	0.02	2.84
Paper, paper production, printing and publishing	53.00	0.01	59.00	0.01	59.00	0.01	1.18
Chemicals, petroleum, coal, rubber and plastic	2,201.00	0.35	2,507.00	0.34	2,829.00	0.31	56.58
Non-metallic minerals except petroleum & coal	274.00	0.04	304.00	0.04	334.00	0.04	6.68
Basic Metal	308.00	0.05	365.00	0.05	419.00	0.05	8.38
Electricity, gas and water	630.00	0.10	640.00	0.08	605.00	0.07	12.10
Construction	49,954.00	7.90	57,552.00	7.71	65,199.00	7.21	1,303.98
Services	280,148.00	44.28	358,650.00	48.02	436,399.00	**48.27**	8,727.98
Restaurants & Hotels	5,188.00	0.82	7,305.00	0.98	10,128.00	1.12	202.56
Transport & Storage	95,086.00	15.03	113,163.00	15.15	136,222.00	15.07	2,724.44

Source: CSO

NG in Industrial Applications

Globally, there are a variety of applications of NG, or Methane. It is used as an ingredient in the production of some fabrics, plastics, anti-freeze and fertilizer. The energy from the NG is used by food processors, petroleum refineries and companies that work with stone, clay and glass products. Methane-based heating enables businesses to dry, dehumidify, melt and sanitize their products. The use of methane in commercial environments mirrors residential uses, such as cooking and heating, but on a larger scale. Further, in the chemical industry, methane is a feedstock for the manufacture of methanol (CH3OH), formaldehyde (CH2O), nitro methane (CH3NO2), chloroform (CH3Cl), carbon tetrachloride (CCl4), and some freons.

For the purposes of this Feasibility Report, the utilization of NG as a feedstock will be limited to its present application as feedstock for fertilizer production, as a thermal energy source, e.g., for brick kilns, and for cooking. The development of high capital cost projects like refineries, methanol plants, and similar users of methane was deemed slightly speculative in nature and should not be included as a foundation element in this Feasibility Report. Instead, this Feasibility Report will focus upon the simplest and most reliable applications of NG in order to produce the more conservative results. The ultimate development of any refineries, methanol plants, and similar users in Afghanistan would be considered as a bonus consumer, which could probably pay a premium purchase price.

2.4 Brief Description of the Hydrocarbons Sector in Afghanistan

Driven by imported oil utilization, the hydrocarbons sector was one of the growing sectors during the past 10 years. In addition to utilization of traditional energy sources such as firewood, animal dung, charcoal, and hydropower for cooking and heating, there is heavy reliance on the hydrocarbons sector to satisfy energy needs, which will likely become progressively more important, particularly in the urban areas. This section focuses on the supply, demand and price evolution of most hydrocarbons used in Afghanistan. First, the structure of market is examined and then the importation of gasoline, diesel and

LPG, which dominate market, is considered. Then the demand for the various sectors is analyzed and finally, the price behavior is assessed

2.4.1 Supply

The absence of significant internal production and the high growth of hydrocarbon imports, some market restrictions[2] and low quality of oil are the main features of the Afghan market. There is currently very little domestic production of crude petroleum products in Afghanistan. Some reserves of oil were discovered in the country in the late 1960s. In fact, an oil field, Angot in Sar-e-Pul, was developed, but oil production was intermittent, with daily outputs averaging 500 barrels per day or less. This field continues to produce small quantities of crude oil, and primitive means are used to refine the oil produced at the field in Sar-e-Pul.

Prior to the early 1990's the government had the monopoly on the imports of petroleum products and regulated the price. In 1991, in order to boost supply, the privatization of the fuel trade was announced but did not prevent shortages of fuel. The State's political collapse in 1992 put in place a real and "natural deregulation" and liberalization of the petroleum market.

An oligopolistic structure of market is the second feature of hydrocarbon market in Afghanistan. Even though there is not presently a vertical structure of the hydrocarbon market, it is evaluated on that basis in this report. In fact, while it is possible to have small or medium pump stations, the importing of large quantities of fuel requires significant capital and is too difficult for modest size companies. Thus, the number of suppliers is limited due to barriers to entry and the market is dominated by medium and large players with comfortable margins versus negligible margins for small participants. Competition between the market players is not fierce, since there is sufficient demand for all of them. Many of these companies also trade in LPG. The main importers are Gas Group, Ghazanfar Group, Azizi Hotak Group, Dawi Oil, and SunGas. Foreign companies like the American company, Tryco, have provided petrol, diesel and aviation fuel to government departments, Coalition Forces, international organizations, some airlines, and other large customers.

Regarding the imports of diesel, gasoline, and LPG, as shown in Table 11, it can be observed that the relative energy share for diesel represents nearly 50% of imported fuel, followed by gasoline at 37%, and LPG at 13%. Between 2003 and 2011, the mean growth rate for oil imports was very high. In 2011-2012, Afghanistan spent US$2.1 billion for its energy imports. The deficit of the trade balance was US$6 billion so the share of energy import in the deficit was 35%.

Table 11: Petroleum Imports

	Unit	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
LPG	000 Tons	1.8	49.6	86.4	94.3	73.3	110.4	88.0	122.2	174.1	226.3
Gasoline	000 Tons	93.0	103.3	147.6	192.5	157.6	114.5	95.0	157.0	572.4	614.1
Diesel	000 Tons	134.6	325.1	269.2	241.4	320.0	361.2	215.3	356.1	679.8	1,118.1
Total	000 Tons	**229.3**	**478.0**	**503.1**	**528.1**	**550.9**	**586.1**	**398.4**	**635.2**	**1,426.3**	**1,958.5**

Source: Ministry of Commerce, Petroleum products and liquid Gas Enterprise

Geographic distribution of trade is very large relative to the 1960's and 1970's when the Soviet Union accounted for some 80% of Afghanistan's petroleum products imports. Today, due to liberalization of commerce, many countries have involved in this industry. Nearly all petroleum products are imported from neighboring countries, mainly Turkmenistan plus Uzbekistan, Russia and Kazakhstan, see the

[2] Generally associated with low competition inside the supply.

following Table 12. All transport of bulk imported supply is handled by road tanker since the short rail transport to Mazar is not useful for such purposes. Fuel is imported into Afghanistan via Aquina, Torgundi and Hairatan in the north, Islam Qala and Zaranj in the west and Torkham and Spinboldak in the south and east.

Table 12: Oil Derivatives Imports by Country

Country	LPG		PETROL		DIESEL		TOTAL	
	Quantity (000 Tons)	Value (000 US)	Quantity (000 Tons)	Value (000 US)	Quantity (000 Tons)	Value (000 US)	Quantity (000 Tons)	Value (000 US)
Azairbaijan	-	-	10	6,244	0	218	11	6,462
China	1	512	-	-	-	-	1	512
Iran	1	364	24	15,262	75	45,528	100	61,154
Latvia	-	-	14	9,149	-	-	14	9,149
Kazakhstan	37	14,611	43	26,938	33	20,938	113	62,487
Pakistan	0	1	12	7,572	56	34,534	69	42,107
Russia	5	2,034	68	42,206	212	127,478	284	171,718
Saudia Arabia	0	15	-	-	0	103	0	118
Tajikistan	0	56	57	35,993	33	20,315	90	56,365
United Arab Emirates	0	41	-	-	0	130	0	171
Turkey	0	142	-	-	-	-	0	142
Turkmenistan	127	50,912	210	129,494	157	94,863	495	275,269
Uzbekistan	34	13,443	132	82,059	181	109,994	346	205,495
Total	**205**	**82,130**	**569**	**354,917**	**749**	**454,100**	**1,523**	**891,147**

Source: Central Statistics Organization

The quality of hydrocarbon products is a significant issue in Afghanistan because the oil by-products supply in the market generally is low quality. There are some pump stations supplying acceptable oil by-products, but the market is dominated by low quality products.

Some measures were undertaken to reduce demand, for example, the interdiction of imported cars aged more than ten years or the week-end day's extension to reduce vehicular traffic. To the extent that Afghan NG displaces some hydrocarbon imports (gasoline reduced by CNG, LPG reduced by NG, etc.) then the impact on exporters would be diffused rather than concentrated on a few suppliers.

2.4.2 Demand

Demand for energy in Afghanistan follows the general trend observed in developing countries with some particularities. In most developing countries, energy consumption is likely to increase dramatically, due to the improvement of living standards, population growth, rapid urbanization and the gradual substitution of commercial energy for non-commercial sources (such as LPG replacing firewood). Traditionally, demand for hydrocarbons products was never very high due to weakness of economic development of the country, but during the three past decades, two factors have boosted the demand: military demand during the 1980's and GDP growth.

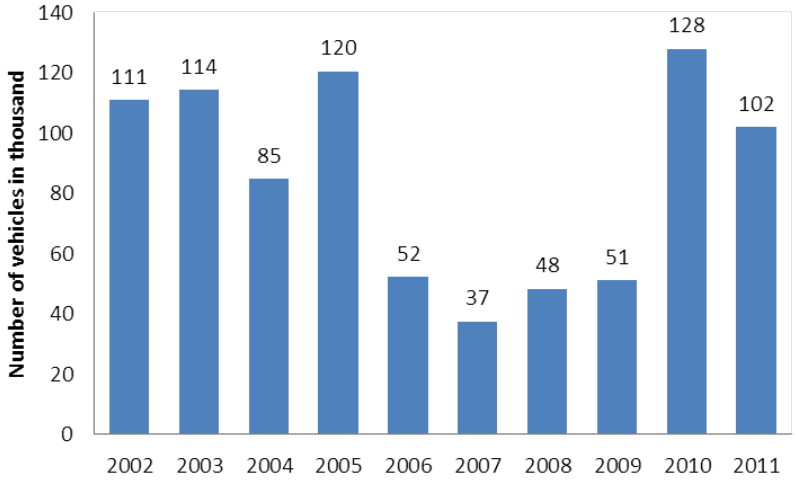
Three factors influence hydrocarbons demand: residential (especially for cooking and heating, power generator), transportation and commercial/industrial. In Afghanistan, the demand for the three elements is growing, usually associated with rising GDP, despite the oil price increase. Residential and commercial/industrial demand is growing, in particular, in urban areas.

<u>Diesel</u>

Currently, diesel fuel is used for civil and military transportation as well as for electricity production uses and overall diesel demand is higher than gasoline. For instance, due to the greater fuel efficiency, diesel vehicles are generally preferred over gasoline vehicles. Most Afghan vehicles, including passenger cars, have diesel engines and, as shown in Figure 11, following the major economic activity

of the last few years, there was an increase in the number of the vehicle imports while the oil derivatives imports also increased.

Figure 11: Imported Vehicles in Afghanistan



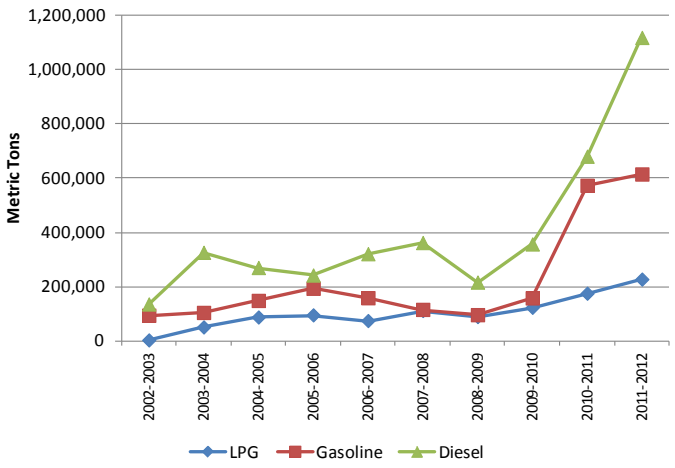
Demand for transportation is most significantly affected by military demand. And the reduction of that demand is expected in the future with the NATO troops withdrawal, which would lead to a notable decline in total demand. Demand variation depends on various factors, such as the structure of the market, existence of substitute products, nature of product, etc. However, the main factor will be the future evolution of GDP growth. If economic growth continues on the same path as in the past, the demand will increase. Otherwise, the demand will adjust, at least in short term, as was apparent before 2001.

LPG

Several factors facilitated LPG's demographic growth, i.e. growth of demand; growth of income; lack of other kinds of suitable energy; urbanization; transport facilities, especially in areas with difficult access; simplicity of use; regulatory measures imposed on the commercial and light industries sector; and its relative cheaper price than wood for urban households.

There was not significant information about LPG consumption for all sectors for a thorough assessment. Some studies estimated consumption of LPG at 67,000 tons in 2009-2010. It was assumed that all imported hydrocarbons were consumed domestically and there was no re-export. The relevant statistics are presented in the following Figure 12.

Figure 12: Oil Derivatives Demand in Afghanistan



Although demand for all hydrocarbon products is growing, the growth of demand for LPG is regular and less impacted by economic and others phenomena.[3] That means this demand is more inelastic. In 2011-2012, the value of imports of hydrocarbons (gasoline, diesel, LPG) was US$891 million. For imports of these three products, the share of diesel represents nearly 50% followed by gasoline at 37%, and LPG at 13%. And in 2011-2012, Afghanistan spent over US$2 billion for its energy imports. The deficit of the trade balance was US$ 6 billion and the share of energy in the deficit was 35%.

2.4.3 Prices

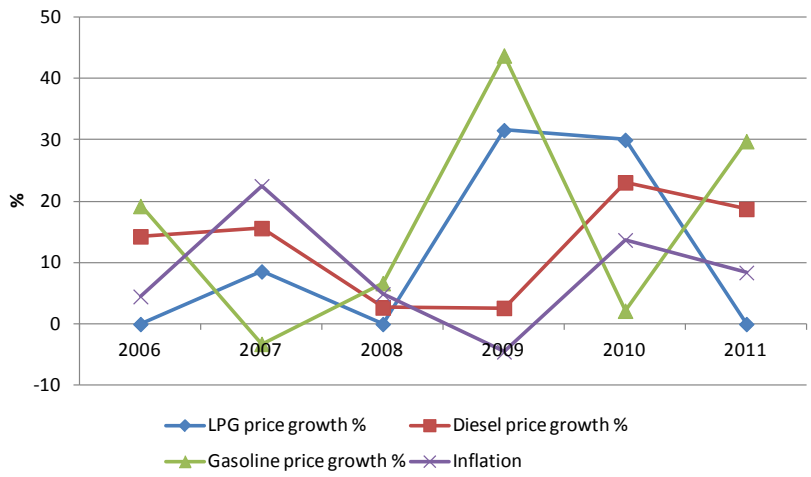
Before 1991, the government had a monopoly on the trade of petroleum products, the objective was to establish strategic reserves to protect the country against shortages and price fluctuations. The end of the old regime led to the disappearance of the monopoly and the organization in charge of this activity in the Ministry of Commerce became the Department of General Petroleum Product. This organization still influences pump stations to provide petroleum products at slightly lower prices, but no longer has the monopoly. There was a lower degree of pass-through when Afghan government used oil price subsidies. Now, fuel prices are nearly completely deregulated and the difference between the government and open market prices is not significant.

Fuel market prices as a good economic indicator should resume and reflect information about supply and demand. In Afghanistan, economic and non-economic reasons influence hydrocarbons prices. International price fluctuations, cost of transportation, climate, taxes and market structure, income, and price elasticity are main economic factors impacting prices.

Afghanistan is a net importer of hydrocarbon products so international price variations have an important impact on domestic fuel prices. So, there is imported inflation combined with domestic inflation that has a significant impact upon livelihoods and economic growth, as illustrated in the following figure.

[3] In 2012-213 household LPG consumption was between 15-20 Kg per month. Average price is 55 Afg (1.07 US$). So, the share of household income (GDP per capita) spent on LPG would be 3% (22 US$).

Figure 13: Growth of Oil Derivative Prices and Inflation



As shown above, in Figure 13 the national inflation rate and the growth of LPG and diesel prices generally follow the same path. There is a positive correlation between the national inflation rate and diesel, whereas the correlation between inflation rate and growth of gasoline prices is negative. Current prices (as of January 2013) for LPG, gasoline and diesel were 64 Afs (US$1.25), 56 Afs (US$1.11) and 62 Afs (US$1.21), respectively, close to international prices, but high-quality gasoline (Super 95) is sold at a higher price per liter.

Even the pass-through effects from international to domestic energy prices are significant in a country like Afghanistan; however, relatively contained inflation rates suggest that the overvalued rate of the Afghani relative to US dollar and neighboring countries currencies seems to have limited the impact of fuel prices on the overall price level.

The demand for oil products in developing countries like Afghanistan typically does not decrease due to elasticity effects. Demand for oil products remains the same even with price increases, i.e. demand is inelastic regarding fuel prices. Income elasticity of demand seems to be over 1. The combination of both elasticity and income increase the demand for hydrocarbons products. However, increases of GDP and GDP per person are the main contributors to the demand developing over the past ten years.

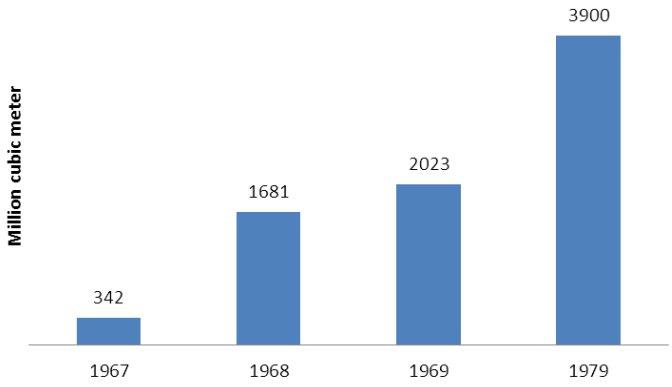
3 Definition and Analysis of the Current NG Market in Afghanistan

From the late 1960's until the 1980's, NG production was an active and dynamic component of the Afghan economy. After their initial exploration work, with Soviet technical assistance, production started modestly during the1960's and increased, achieving its peak level at the end of 1970's. The decade of the 1980's was the beginning of the economic and political disturbances that seriously damaged the Afghan economy. The NG industry along with other sectors of the economy suffered dramatically. This negative impact had severe consequences on the Afghan economy since the NG industry was one of the most important sources of foreign exchange to finance Afghanistan's economic development.

3.1 Size of Supply – Current Afghan NG Production

Development of the NG industry was one of the priorities of Afghanistan, in fact, gas was included in the second plan in 1957 in order to support economic growth of the country and create an economic pole of development. The production in 1979 was ten times more than the beginning level of exploitation, as shown in the Figure 14 below.

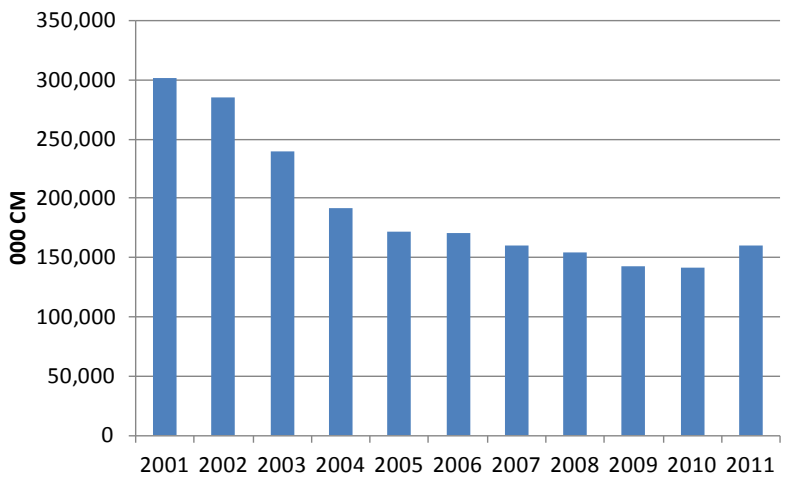
Figure 14: Previous NG Production



Many exploration missions were conducted and the production started modestly in the 1960's before reaching its peak in the 1970's. Around 144 wells were drilled, of which about half were completed as production/exploitation wells. Today, the total NG production comes from the northern regions, principally near Sheberghan, the capital of Jowzjan province. There are about 24 active NG wells in Sheberghan and the gas supply is brought to residential and commercial sectors in Sheberghan and to the Kod-e-Barq-e Mazar-e-Sharif project by pipelines that moves the gas from producing and storage areas.

Although the reserves of NG in the proven and probable categories are substantial, the current production of NG represents only 5% of that peak rate of the 1970's. As shown in Figure 15, for the 2011-2012 period, total reported NG production was 160.354 MMCM, a small increase (11%) from the 2010-2011, but that increase was due to one well rehabilitation and not driven by sustained structural measures.

Figure 15: NG Production



3.2 Size of Demand

The nature and level of demand for goods and services are based on several factors, including the population growth, the number of people per household, the preferences of the population for different forms of energy, national priorities in terms of development of certain industries or economic sectors, the penetration of new technologies or forms of energy in the market, etc.

Internal demand for NG was and is restricted, indeed from the beginning the demand from the former Soviet Union and from the domestic industrial sector was met with the support of the Afghan NG industry. While the delivery of the gas to residential and commercial sectors was a third component, most of NG was exported, due to the economic and political considerations, to the former Soviet Union, who bought at low prices. While the planned objective of meeting residential and commercial demand was not reached, exports of NG were a key component of trade balance, without which the trade balance would have been more negative, as shown in Table 13 below.

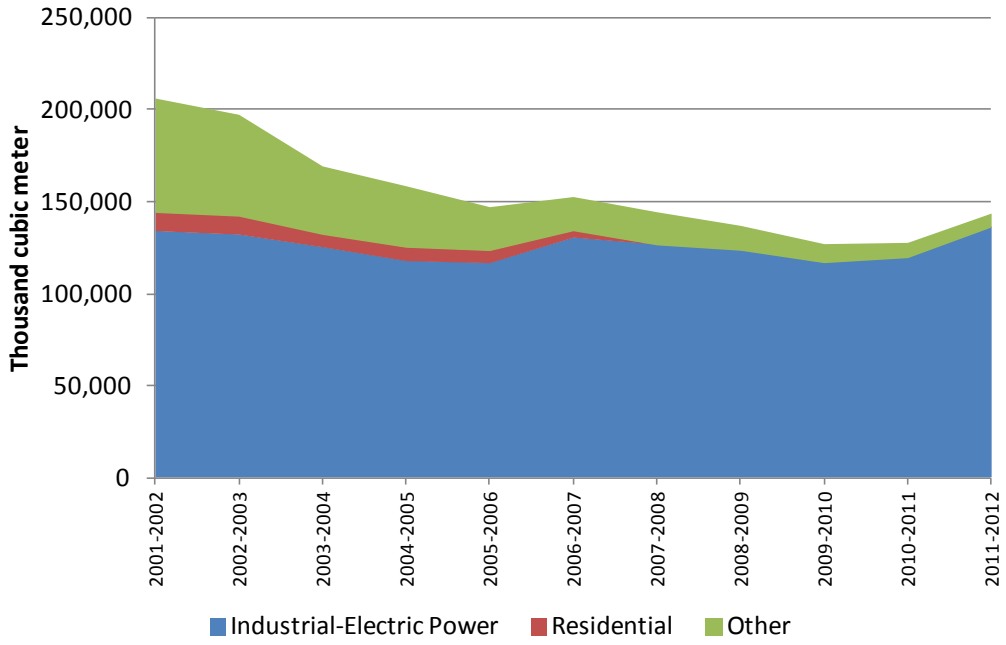
Table 13: Past NG Exports

Concept	Unit	1967-1968	1968-1969	1969-1970	1970-1971	1971-1972	1972-1973	1973-1974	1974-1975	1975-1976 Estimation
Total exports	Million USD	66.4	71.8	81.7	85.1	99.7	124.5	159.1	230.6	235.5
Total imports	Million USD	138.4	124.4	124.8	110.8	153.2	157	182.9	242.5	277.5
Balance	Million USD	-72	-52.6	-43.1	-25.7	-53.5	-32.5	-23.8	-11.9	-42
Natural gas exports	Million USD	2.9	9	12.1	14	14.5	17.1	18	32.1	46.3
Balance without natural gas expots	Million USD	-74.9	-61.6	-55.2	-39.7	-68	-49.6	-41.8	-44	-88.3
Natural gas exports as % of total export	%	4.37	12.53	14.81	16.45	14.54	13.73	11.31	13.92	19.66

Source CSO, Da Afghanistan Bank

The cessation of exports of NG since 1991 and deteriorating condition of the gas infrastructure have worsened the Afghan economic situation. At the present, the lack of supply has restricted demand. Among the three components of current demand, only the demand from the fertilizer and power plant, Kod-e-Barq-e Mazar-e-Sharif, plays a critical role since current demand from local residents and the commercial sector is small, as shown in the graphics below, since the lack of availability of NG forced fuel switching to meet energy needs. Previously, NG was provided to thousands of customers in the Sheberghan area but with diminishing NG supplies, the residential sales have been severely curtailed.

Figure 16: Total NG Consumption by Sector by Year



In 2011-2012, the total annual NG daily production was about 160 MMCM and the gas consumption by Kod-e-Barq-e Mazar-e-Sharif was 136 MCM. More than 85% of production was consumed by the fertilizer and its power plant, Kod-e-Barq-e Mazar-e-Sharif. The average daily gas consumption by the fertilizer plant over the months between January 2012 and July 2012 was 374 MCM.

Table 14: Daily NG Production and Consumption in 2012

Concept	Unit	Progess since starting	Average per month	Average per day	Part of each in %
Production of Natural gas	000 CM	91,868.0	13,124.0	437.5	100.0
Routing to Kodo Barq-e-Mazar	000 CM	78,625.0	11,232.1	374.4	85.6
Routing to others destination	000 CM	3,694.0	527.7	17.6	4.0
Technical expense, wells ventilation	000 CM	3,762.0	537.4	17.9	4.1
Internal expense	000 CM	553.0	79.0	2.6	0.6
Expense and losses	000 CM	5,234.0	747.7	24.9	5.7

Sources: Ministry of Mine, Afghan Gas Enterprise

For the same period in 2005 (December to July) both gas production and consumption amounts were equal while demand for substitute products has increased. That means that the capacity of the production is very low due to minimal investment to modernize the gas infrastructure. According to several studies the Kod-e-Barq-e Mazar-e-Sharif plant is not running at its full capacity, rather at only about 30% of capacity.

3.3 Unmet Demand

Probably the only real unmet demand is the fertilizer plant, which is operating at about 30% of capacity due to the shortage of NG.

In the past there was NG demand from the Silo of Mazar-e-Sharif, a textile factory and a cottonseed oil factory, none of which now operate. When the textile factory was at the full capacity of production, the NG demand per day was 20,000 CMD. These facilities no longer operate for a variety of reasons including non-competitive prices and poorly maintained equipment. While the shortage of NG may have contributed to their closure, the availability of NG is unlikely to resurrect those facilities, so they are not counted as unmet demand. Further, there were far more residential customers in the past than receive NG today. However, their energy demand for cooking, heating and lighting have been certainly been replaced by firewood, LPG, etc., so these are not counted as unmet demand either.

3.4 Market Segmentation

The common definition of market segmentation is a marketing strategy that involves dividing a broad target market into consumer subsets, such as the following: 1) some with common needs (Homogeneity), 2) some with unique requirements (Distinction), and 3) others with similar response to the market (Reaction). After identifying the consumer subsets by needs or market response, it is possible to design and implement strategies to meet their needs and desires. Currently, there is a relatively low level of NG supply and no internal funds to develop more supply or deploy marketing strategies to enhance the customer base. However, there are two projects that will increase supply so some market segmentation work could be appropriate in the future.

The two donor funded projects, the SGDP by the USAID and the Sheberghan Gas Field Rehabilitation Project ("SGFRP") by Asian Development Bank, will increase NG supply by a total of about 2MMCMD. The NG from the SGDP is completely dedicated to the new 200 MW IPP while the SGFRP is targeted at supplying more NG to the fertilizer plant plus other yet unspecified demand.

When the surplus supply from the SGFRP becomes available, then a market segmentation approach would be appropriate to market that NG. Further, when the Low Case and Case 1, 2, or 3 scenarios, described in Section 4.2.1 are implemented, then a market segmentation approach should be applied to sell the NG to the new consumers in the new markets.

3.5 Transportation

Due to the gaseous state of natural gas at normal temperatures, transportation of substantial volumes over a long period is only cost effective via continuously operating pipelines. The transportation of NG is handled through gas gathering systems to the high pressure main gas transmission system pipelines and then through low pressure gas distribution systems to the final consumer. If the NG has impurities, such as water, CO_2, H_2S, etc., then those should be removed prior to the introduction of the NG to the main gas transmission system pipelines.

There is some significant transportation infrastructure around the gas fields and leading from Sheberghan to Mazar E Sharif. There are a number of existing active pipeline segments in use currently as well as some inactive segments. Those assets are listed below as Active or Inactive in the lists below and diagrammed in Figure 17.

Active Pipelines

- Khawaja Gogirdak gas pipeline – Kod-e-Barq pipeline is currently under construction with 89.1 Km length and 320 MM diameter (12 inches). 12 Km of the pipeline will be renewed in 7 points.
- Gerquduq gas pipeline – Khawaja Gogirdak pipeline with 29 Km length and 720 MM diameter (28 inches) is used for the purpose of transferring the low-sulfur gas for Sheberghan city, Aqcha district and CNG.
- Yatimtaq gas pipeline – Gerquduq pipeline with 420 MM diameter and 28 Km length is used for the purpose of transferring the Shakarak and Gerquduq gas to Kod-e-Barq pipeline.
- Shakarak - Gerquduq gas pipeline with 6 Km length and 159 MM diameter (6 inches) is used for the purpose of transferring gas from Shakarak to Gerquduq.
- Baba Dehqan gas pipeline – This pipeline with 159 and 100 diameter (6 and 4 inches) and 13 Km length is used for transferring gas to Sheberghan city.
- Gerquduq factory pipeline- residential area of Gerquduq is active with 100 diameter (4 inches) and 3.5 km length.
- The Khawaja Du Koh district pipeline of Gerquduq is non-standard installed on the ground with 41 Km length and 245 MM diameter (10 inches). Currently; it is used for the purpose of transferring gas from Gerquduq to Sheberghan city and Khawaja Du Ko district.
- Khawaja Gogirdak gas pipeline (28 Km to Aqcha) with 820 MM diameter (32 inches) and 28 Km length is used for transferring of gas to Aqcha district.
- The pipeline from '28 km Gas Pipeline Point' on the way to Aqcha with 13 km length and 159 mm diameter (6 inches) is used for the purpose of transferring gas to Aqcha route and it is non-standard installed on the ground.
- Yatimtaq – Khawaja Gogirdak pipeline with 2 km length and 245 MM diameter (10 inches) is used for transferring Gerquduq and Yatimtaq gas to pipeline of Khawaja Gogirdak to Kod-e-Barq.
- Sheberghan gas distributor pipeline – CNG pipeline with 900 meters length and 100 MM diameter (4 inches) is currently under use for the purpose of transferring gas to CNG.

Inactive Gas Pipelines:

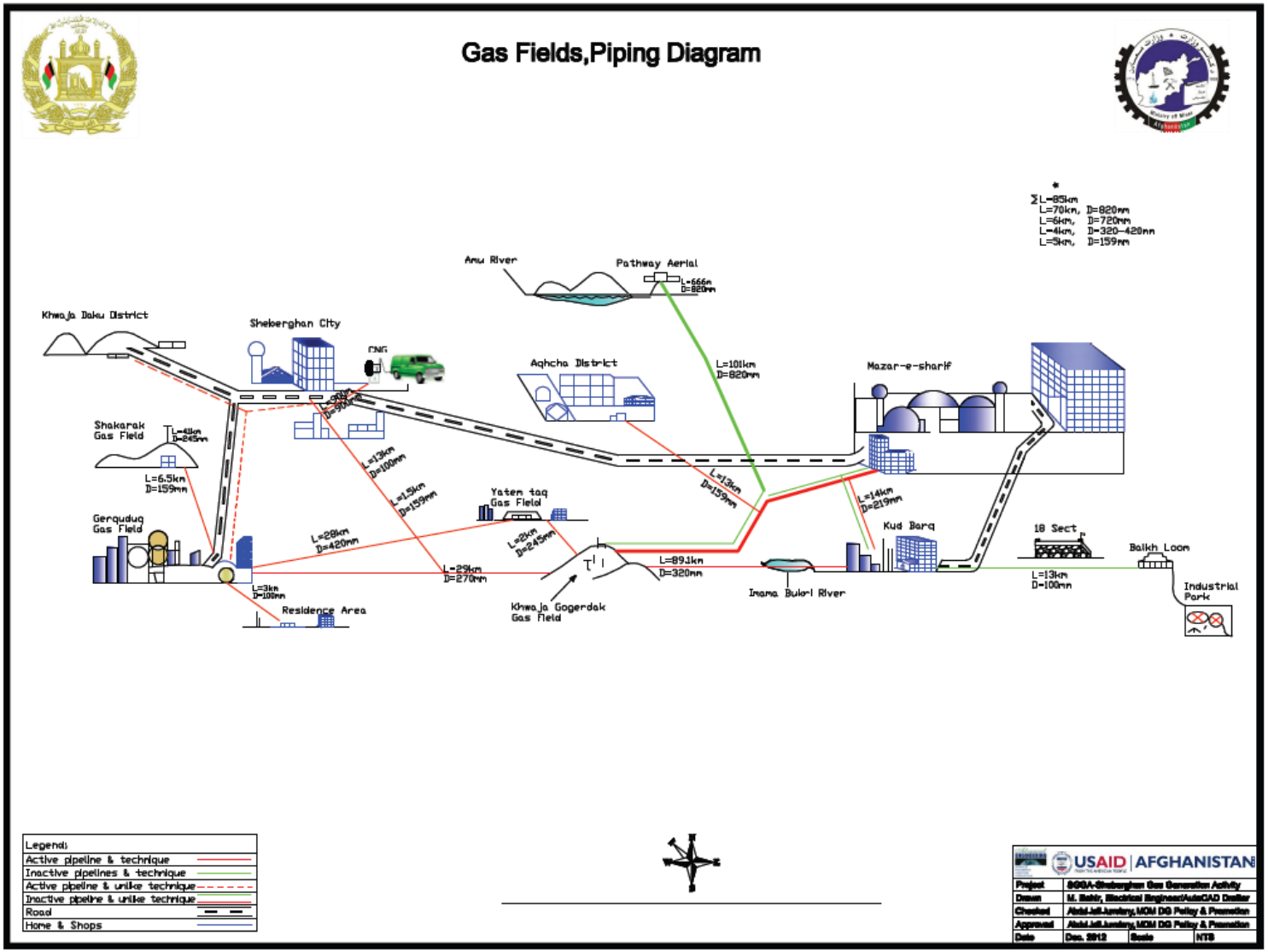
- The Khawaja Gogirdak –Klift gas pipeline with 101 Km length and 820 mm diameter (32 inches) was previously used for transferring and exporting gas to the former Soviet Union.
- The distributor gas pipeline of Kod-e-Barq until textile factory (Nasaji) of Balkh with 100MM (4 inches) diameter was used for the purpose of transferring gas to Military base, Firqe 18 and Balkh Nasaji.
- Balkh Nasaji pipeline to the l Silo of Mazar- e- Sharif with 6 km length and 159 MM diameter (6 inches) was build according to the needs and usable.
- 85 km non-technical and non-standard gas pipes of 820 MM, 720 MM, 420 MM, 219 MM and 159 MM have been extended in Sheberghan-Mazar route on the ground.

Condition of the NG Infrastructure

Due to the years of political insecurity and inadequate funding, many of the NG assets are in poor condition. The existing system should be repaired and/or replaced in order to have a safe, reliable and cost effective transportation system. The pipeline to the Kod-e-Barq-e Mazar-e-Sharif project is being repaired by the TFBSO and the construction of another parallel pipeline is planned by the TFBSO.

In general, due to the age and poor quality of the existing transmission and distribution systems, the SGGA cost analysis assumes that all NG infrastructure, except the repaired pipeline and the new parallel pipeline to the Kod-e-Barq-e-Mazar Sharif project funded by TFSBO, will be replaced by new transmission and distribution systems.

Figure 17: Pipeline in the North – 2013



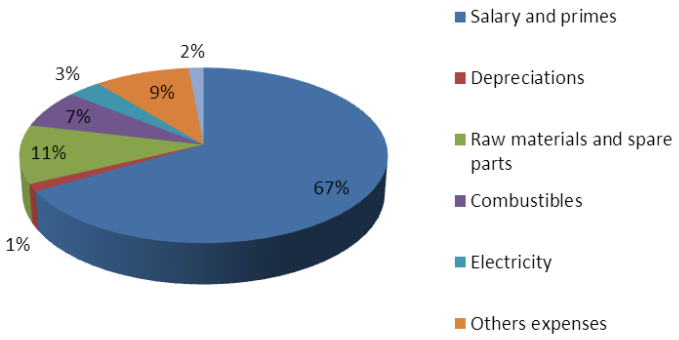
3.6 Pricing

This section presents the NG prices currently charged by AGE to the final consumers and the incremental components, that is, how the weighted average[4] of this price is assigned to the different cost components by the company.

Current Prices

Production, transmission, distribution functions and price policy for NG are the responsibility of the State Owned Enterprise, Afghan Gas Enterprise ("AGE") under the MoMP. According to the information provided by AGE, the current NG cost price is low on a regional basis because, among other things, it is based on the current low cost of production and transportation and it is a regulated price. However, most of the infrastructure for the NG is old and in poor condition so the price does not yet include the funds necessary to perform normal infrastructure maintenance, nor are there funds set aside for gas field development work to replace declining wells. While the salary levels at AGE are not very high, the salaries and contractor costs account for 67% of the gas price. The following Figure 18 shows the different components of the NG price.

Figure 18: Components of the NG Price



AGE charges different prices for residential, commercial and industrial sectors and these prices were relatively flat for many years. The average AGE's sales price in 1391 (2012-2013) is 1.74 AFN per cubic meter (US$34/MCM). The prices charged by AGE to the main consumers are:

- The fertilizer plant and power generation plant, US$34.8/MCM.
- Domestic (residential) use, US$79/MCM.

4 Preconditions to Expanded Demand

4.1 Competitive Gas Pricing

Expanding demand will require more supply plus appropriate demand in terms of adequate prices to cover the costs of sustaining the necessary field development work plus the needed infrastructure construction and maintenance. In particular, the possible levels of the NG price in Afghanistan[5] will be determined by using the prices of the existing alternative sources of energy for consumers and by considering the price that could provide energy and infrastructure investors with reasonable rates of

[4] The weighting was done based on the volume sales to the different consumer classes.
[5] In the future.

return. With these results, the next sections will contrast the volumes projected and the prices associated with these volumes.

This section will present the analysis for the price of NG used for large potential consumption areas: 1) new power plants; 2) CNG; 3) LPG replacement; and 4) coal substitution. In the case of power plants the assumption is that the NG price has to be set to provide a reasonable rate of return for the producer of gas and the generator of electricity *In the absence of real market data to indicate actual investment return expectations, the methodology employed, the Capital Asset Pricing Model (CAPM), is simply a means of hypothesizing numbers to use for calculating other numbers, such as net wellhead prices. As such, the CAPM results are not intended to and do not create any reference point for business negotiations. The real market investment return expectations could be significantly higher or lower.* Since the import of power from other countries is a viable option, then those imported power prices create a potential "ceiling" on the domestic power prices, which must also be considered. For the rest of the energy products, it is only necessary to analyze the current prices of LPG and coal and offer NG as a competitive alternative.

4.1.1 Capital Asset Pricing Model

One of the key elements of the pricing process for NG production and electric power plants, a potentially substantial customer, is the cost of equity. This number establishes the opportunity cost for the investor and, therefore, the minimum return for their investment in one activity in the host country. In this section the cost of equity of the project[6] is determined using the Capital Asset Pricing Model (CAPM) methodology.

The main assumption underlying the CAPM methodology is that a fair rate of return must consider three components: 1) the risk of the activity; 2) the risk of the country; and 3) a risk free rate of return. The following formula represents the equity cost (EC) as a function of a risk free asset returnR_f, the market return (R_m) and the sensitivity of the industry return relative to the market (β):

$$EC = R_f + \beta \cdot (R_m - R_f)$$

These variables have the following values:

1) R_f represents the long term interest rate of US Treasury;
2) R_m represents the lending rate in Afghanistan; and
3) β will be determined from the following sources: a) the data base constructed by Professor Aswath Damodaran, Professor of Finance at the Stern School of Business at New York University;[7] b) Camacho; Rocha & Bragan (2006) and; c) Koch, N. & Bassen, A. (2012). The following Table 15 presents the β for Sheberghan Gas Development Project (SGDP):

Table 15: Betas used in the CAPM Analysis

Sector	Beta
Drilling	2.23
Processor Plant	0.98
IPP	0.69 - 1.14
Transmission	0.54 - 0.63
Distribution	0.54 - 0.63

The estimation of the *country risk* can be made using the lending rate for Afghanistan and the US

[6] NG production and electricity generation.
[7] http://people.stern.nyu.edu/adamodar/New_Home_Page/datafile/totalbeta.html

Treasury rate of interest (for 10 and 20 years), the risk associated with an investment in Afghanistan can be estimated by the difference between this two factors,[8] the results can be found in the following table. For the purposes of this document we will use the average of the results for 2011 (11.63% - 11.53%), which give a country risk equal to 11.58% and a rate free of risk of 3.97%.

Table 16: Risk Estimation for the CAPM Estimation

Year	Lending Rate Afghanistan (1)	US Treasury Rate if Interest (10 years) (2)	US Treasury Rate if Interest (20 years) (2)	Difference LRA & UST 10 years	Difference LRA & UST 20 years
2008	14.92%	4.24%	4.36%	10.67%	10.56%
2009	15.00%	3.97%	4.11%	11.03%	10.89%
2010	15.69%	3.88%	4.03%	11.81%	11.66%
2011	15.15%	3.52%	3.62%	11.63%	11.53%
Average	**15.19%**	**3.90%**	**4.03%**	**11.28%**	**11.16%**

Source:

(1) International Monetary Fund

(2) US Department of the Treasury

Using the numbers explained previously, the following tables present the estimated equity costs for each part of the supply chain segment. As expected, the equity cost for the drilling activity is the highest, because of the relative inherent risk, so the Business Unit in charge of the drilling and processing plant could have, in average, a return of 20% (see Table 18). Of course, it will be lower or higher depending on the cost allocation between these activities.

Table 17: Equity Cost for Selected Activities

Sector	Equity Cost
Drilling	29.8%
Processor Plant	15.3%
IPP	12.0% - 17.2%
Transmission	10.2% - 11.3%
Distribution	10.2% - 11.3%

Table 18: Equity Cost for E&P and Gas Processing Investment

Concept	Unit	Initial Investment	EC
Drilling	000 US$	37,000	29.50%
Plant & others	000 US$	80,000	15.30%
Total	000 US$	117,000	19.79%

Using the Economic Model created by SGGA, an IRR of 17% for the power plant and 20% for the investment in the drilling and processing plant would result in a US$120/MCM price for the NG used in the generation of electricity.[9] NG transmission and distribution functions are generally lower risk activities with a commensurately lower rate of return. Establishing and maintaining a NG transmission and distribution system will require CAPEX to develop the gas fields, gas processing plants, transmission and distribution system and OPEX to operate and maintain the gas fields and the

[8] Using the 10 and 20 years interest rate for US Treasury.

[9] The main assumptions of the Economic Model are: 1) total capacity of 200 MW; 2) 85% of dispatch rate; 3) Power plant heat rate after auxiliary 9,915Btu/kWh; 4) Heating value of gas is 960 Btu.

supporting infrastructure. The appropriate return for a NG transmission and distribution system will be based upon the weighting of the CAPEX and OPEX costs of each component. *Although the CAPM analysis produces 10.2 – 11.3% return requirements for pipeline and distribution investments, it has been more conservatively assumed in the cash flow analyses in Section 4.3 that a higher rate, 15%, may be needed to mobilize the investors for those segments.*

4.1.2 Competing Energy Sources

The sources of energy that will compete with NG in Afghanistan are: 1) coal used in primary industries; 2) LPG used in small food processing industries; 3) LPG used by families (households) especially for cooking and heating purposes; 4) gasoline used by cars (vehicles) as fuel.[10] The price and volumes of LPG and gasoline in Afghanistan were addressed previously in section 1.3.3 Prices, so the price and volume of coal are reviewed below.

4.1.3 Coal Market and Prices in Afghanistan

Since coal will be the main competitor for NG in the industrial sector and this sector is a potential consumer of large amounts of NG, this section will review some key characteristics of the coal market in Afghanistan.

<u>Supply</u>

The debate on the quantity of Afghan coal reserves is similar to that of the other Afghan natural resources; it is a polemic and controversial matter. The current reserves of coal are estimated between 163 and 243 million tons, but this level of reserves is modest when compared with some neighboring countries. For example, the estimated reserves in China and India are the most substantial in the region; nevertheless, the consumption is also high as well, see Table 19.

Table 19: Production and Reserves of Coal in Afghanistan and the Region

Country	Reserves (Million tons)	R/P	Production (Million Tons)
China	114,500.0	32.5	3,520.0
India	60,600.0	103.0	588.5
Pakistan	2,070.0	647.7	3.2
Kazakhstan	33,600.0	289.8	115.9
Afghanistan	243.0	164.2	1.5

Source: BP, MoMP

The majority of known Afghan coal reserves are located in the center, the north and west of the country with the most important reserves being in Ashpushta, Dari Suf, Nahreen, Karkar/Doodkash, Roi Dohaab in Northern Provinces, Sabzak in the west, and Khawaja Ganj in the center. Between 1969 and 1978 the coal production increased and reached its historical peak level of 212,000 tons in 1978, but then declined later. According to MoMP between 1991 and 2001 production level fell to 25,000 tons/year, because of the civil war period and decreases in government support. After 2001, the new economic policy led by the government resulted in a partial privatization of this sector, according the MoMP, the most recent developments are:

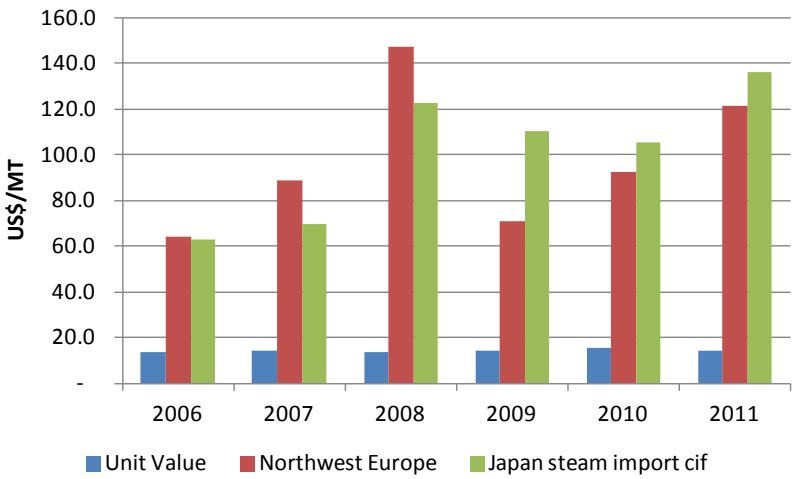
[10] NG can be used in other activities as well, nevertheless, these are the activities (and prices) used in this Report, because, among other things, the availability of data.

- Northern Coal Enterprise (NCE) is a State-Owned Enterprises and the largest coal operation in Afghanistan. In 1389 the company produced 725,000 tons but, NCE coal sales were 752,000 tons using stockpiled coal from 1388 production.
- In1388, all Sabzak coal properties were licensed to "Khoshak Brothers".
- In 1388, 4 of the 10 active coal mines under NCE were included in a long term lease to the Afghanistan Investment Corporation (AIC) as part of the Ghori Cement lease.
- In 1386, coal mines in the Ashpushta Basin were licensed as part of the Aynak copper award.

It appears the current privatization policy and the international aid has improved the situation. In fact, the level of production has increased since 2001, for example, when the production reached their high level of about 1.5 million tons. While today both public and private sectors are active, most of the production is done through the state owned enterprise, NCE. According to MoMP and based on the NCE reports, during the past three years NCE has transferred AFG 1,309,652,267 (US$29.1MM) in taxes to provincial administrations, making NCE one of Afghanistan's largest taxpaying State Owned Enterprises. Total government revenue from coal (taxes, production revenue) in 2012 would be US$43 MM.

Regarding the production value, Figure 19 presents the unit production value (without transport, commercialization and taxes) in Afghanistan and the contrast with international price data.[11] Clearly, the production costs are low in Afghanistan, so there's an opportunity to export the production to other countries. In fact, the main external market is Pakistan.

Figure 19: Production Value and International Prices - Coal



Demand

The demand for coal is high and depends essentially on the construction sector (including brick kilns), food processing, plus the commercial and residential sectors. There is still no electric generation by coal in Afghanistan. The largest domestic users are the brick kilns and gypsum factories, in particular in Kabul and the Northern provinces. Importantly, most of the production (50% or more) is exported, mainly to Pakistan.

In 2012-13, the industrial/commercial demand for coal from five provinces (Balkh, Jowzjan, Faryab, Samangan and Sar-e-Pul) was estimated at 0.37 million tons, that represents about 20% - 25% of

[11] Source: BP.

production. Consequently, if the external (Pakistan) and internal demand changes it will affect the production, since there are no other ready markets.

Price

The market price for domestically consumed coal depends on costs of production, transportation, margin and taxes. As stated earlier, part of production is generated by the private sector but NCE sells the most coal. The reason, according to MoMP, is that NCE's production numbers actually represent production by the independent coal miners and then NCE buys their production according to the following price scheme:

1) Category 1 – highly mechanized mining – 400 AFG/MT (US$7.7/MT)
2) Category 2 – medium – 500 AFG/MT (US$9.6/MT)
3) Category 3 – difficult conditions, no equipment, bring own tools – 600 AFG/MT (US$11.5/MT)

The wholesale domestic price of coal is capped by 1386 Cabinet Decree at 2,100 AFG/MT (US$40.4/MT). The current market price of coal in Mazar in April was between AFG 50 and AFG70 for 7 Kg (US$137-192/MT).[12] According a transporter-seller of coal in Mazar, the purchase price of coal at the mine is around 1,200 - 1,400 AFG/MT (US$/MT 23 - 27), plus about 200 Afghanis (US$3.8/MT) for others costs. A report from the BBC confirmed the same information. The export price would be between US$70 - 90/MT, while the current Chinese and Pakistani prices for coal range between US$95-98/MT while the thermal coal CAPP price is US$58/MT. As a large part of coal is exported to Pakistan, the internal coal price evolution depends on the export volume.

The current exportability of coal is an important feature when an alternative fuel is being proposed. Coal is a solid, can be stored with no real degradation, transported by simple means and the regional market is large and has attractive prices. NG, on the other hand, requires very large capital investments to build the pipelines and distribution systems; while storage systems are complex and expensive to build and operate.

Even with some price cutting to support increased exports, the coal industry should be able to successfully adapt to the displacement of its domestic market around the proposed pipeline. The alternative of supporting the coal industry over the NG industry could seriously limit the development of the NG industry in Afghanistan, except for its use for power generation fuel.

Competitive Pricing of NG

Table 20 presents the price of gasoline, coal and LPG in Afghanistan during the first semester of 2013, in local currency (AFN) and in US$.

Table 20: Current Energy Prices

Product	Unit	Price (AFN)	Price (US$)
Gasoline	Liter	50.0000	0.9091
Coal	Kg.	10.0000	0.1818
LPG	Kg.	54.0000	0.9818

[12] Approximately 1 US$ = 52 AFG.

Table 21 presents the prices of the same three products but in equivalent terms for NG[13] and are expressed in US$/MCM. Also, this table presents the proposed final consumer price of the NG according to each product that it would seek to replace. That is, if the NG has to replace gasoline, then the maximum consumer price of NG should be US$636/MCM; in the case of coal the price should be US$182/MCM; and to replace LPG the price should be US$517/MCM.[14]

Table 21: NG Equivalent Energy Prices and Proposed NG Prices

Product to be replace	Unit	Max. Consumer Price (US$)	Proposed Consumer Price (US$)
Gasoline	MCM	909	636
Coal	MCM	260	182
LPG	MCM	739	517

These proposed final consumer NG prices represent sufficient discount levels (30%) to induce consumers to switch fuels as well as to counter competitive price responses by those alternate fuel suppliers. Also, it is very important to note that most of the NG volumes will replace coal use by commercial and industrial consumers. Domestic coal prices are currently priced well before export prices and domestic price creates a low ceiling price against which the NG must compete.

A significant inducement, the 30% discount, is assumed since the final consumer may incur costs to switch fuels. For example, there would be conversion kits for vehicles to switch to CNG, distribution line costs for industrial and residential consumers' connections and meters, etc. Additionally, it is likely that the suppliers of competing fuels could lower prices to combat the NG competition. The 30% discount is intended to cover both conversion costs and competition.

There are some additional benefits of NG versus the other fuels but it does not appear that those would be valued in Afghanistan in the near future. For example, the combustion of NG is much cleaner than coal and gasoline from an environmental perspective. Coal has ash disposal costs and gasoline creates carbon build-up in engines and requires more frequent maintenance of engines. However, it was deemed unlikely that consumers would attribute any significant cost savings to those benefits so the 30% discount was not adjusted by those additional, unquantified environmental/economic benefits.

4.2 Forecast Demand

This section reviews the Forecast Demand from the Northern Provinces and Kabul based on competitive pricing plus the economic constraints that will affect the use of NG by potential customers. A preliminary routing of a pipeline system along with appropriate distribution systems has been assumed, as described in the following section. Then, on the basis of the potential and likely consumption of the NG by the relevant consumers, demand volumes can be predicted. The main goal is quantify this demand under certain scenarios and compare with these results with the price analysis and the quantity of NG reserves in the country.

[13] The conversion factors used are: 1 Kg of LPG = 47 CF of NG, 1 Ton of Coal = 698 CM of NG, 1 CM of NG = 35.375 CF of NG, finally 1 CM of NG = 1 liter of gasoline.

[14] The approach was to price the equivalent NG energy at 70% of the price of the replaced energy. This approach is currently applied in Afghanistan with CNG used in vehicles. However, according to the legal framework of Afghanistan the maximum CNG price will be 50% of the gasoline price. In any case, the 70% approach will be a moderate application regarding the NG well head price.Also, according to information from the MoMP, there's no policy to replace the coal use in Afghanistan, then, the numerical excerise in this document has to be taken as an hypothetical case.

4.2.1 Scope and Scenarios

Considering previous studies about the development of NG market in Afghanistan, this report will evaluate the conditions in the urban areas of the following regions: 1) Balk (Mazar-e-Sharif); 2) Jowzjan (Sheberghan); 3) Samangan; 4) Baghlan; 5) Kunduz; 6) Parwan (Charikar) and; 7) Kabul. The following Figure 20 shows the location of the main urban areas of these regions and the main roads between them.[15]

Figure 20: Regions in the North of Afghanistan Analyzed in the Report

After analyzing Figure 20, it is apparent that it will be necessary to install two pipelines to provide NG to Kabul and Kunduz, one primary transmission line from Sheberghan to Kabul and a spur from Baghlan to Kunduz, see Table 22, below, for the distances between the load centers. This Report considers four scenarios:

1) Low Case: this scenario consists of the supply of NG only to Sheberghan and Mazar - E - Sharif and the installation of a Power Plant of 200 MW in Sheberghan, very close to the fields.
2) Case 1: in this scenario the supply of NG will be from Sheberghan to Kabul and to Kunduz, with one Power Plant in Sheberghan of 200 MWs and another Power Plant in Kabul[16] of 200 MWs.[17]
3) Case 2: in this scenario the supply of NG will be from Sheberghan to Kabul and to Kunduz, one Power Plant in Sheberghan of 200 MWs and another Power Plant in Kabul[18] of 400 MWs.[19]
4) Case 3: in this scenario the supply of NG will be from Sheberghan to Kabul and to Kunduz and includes Power Plants near Sheberghan of 600 MWs.

[15] Typically, a NG pipeline project uses the course of the existing roads as an initial estimate of its possible path.
[16] In this case, it is necessary to transport the natural gas to generate electricity in Kabul.
[17] In total 400 MWs.
[18] In this case, it is necessary to transport the natural gas to generate electricity in Kabul.
[19] In total 600 MWs.

Table 22: Distance between Provinces

From	To	Distance (Km)	Distance (Miles)
Sheberghan	Mazar	130.0	80.5
Mazar	Half Way	183.0	114.0
Half Way	Baghlan	26.6	16.5
Baghlan	Kunduz	71.0	44.1
Half Way	Charikar	141.0	87.8
Charikar	Kabul	56.9	35.4
TOTAL		608.5	378.3

Half Way mean the cross between the 2 routes

Demographics are one of the economic foundations of this report: total population, the number of households, and the rate of growth of each province. For that reason, Table 23 and Table 24 present the supporting statistics and assumptions for these variables. The source of this information is the Central Office of Statistics ("CSO") in Afghanistan and the National Risk and Vulnerability Assessment ("NRVA") survey made in 2007 - 2008 and the application of these numbers will be discussed in the next sections.

Table 23: Population and Households in Provinces

Province	NRVA Survey 2007 - 2008				Central Statistics Organization 2012 - 2013			
	Rural		Urban		Rural		Urban	
	Population	Households	Population	Households	Population	Households	Population	Households
Balk	743,950	110,280	401,107	55,848	794,900	117,833	450,200	62,683
Jawzjan	377,765	58,928	98,770	13,936	403,500	62,942	108,600	15,323
Samangan	345,091	49,736	N/A	N/A	341,000	49,146	27,800	3,896
Baghlan	647,154	84,576	157,666	18,752	691,100	90,319	172,600	20,528
Kunduz	670,414	85,288	212,556	24,096	716,800	91,189	237,000	26,867
Parwan	589,788	76,600	N/A	N/A	576,000	74,809	55,600	7,793
Kabul	598,745	76,192	2,849,719	394,536	640,900	81,556	3,309,400	458,178

Source: NRVA Survey, CSO.

Table 24: Population Rate of Growth and Family Size in Provinces

Province	Annual Rate of Growth		Family Size	
	Rural	Urban	Rural	Urban
Balk	1.33%	2.34%	6.7	7.2
Jawzjan	1.33%	1.92%	6.4	7.1
Samangan	-0.24%	-0.24%	6.9	7.1
Baghlan	1.32%	1.83%	7.7	8.4
Kunduz	1.35%	2.20%	7.9	8.8
Parwan	-0.47%	-0.47%	7.7	7.1
Kabul	1.37%	3.04%	7.9	7.2

Source: NRVA Survey, CSO.

4.2.2 Methodology

In order to understand the current demand and to forecast the future demand, different methods are used. The official statistics were obtained from diverse sources; in particular, the CSO supplied information about the hydrocarbon market in Afghanistan. However, the apparent lack of precise information required the extrapolation of some details.

By using different sources and reports it was possible to approximate the demand for NG. In order to establish the reasonableness of the numbers, the analyses in this report used data from different public and private institutions like Municipalities, Regional Chambers of Commerce, Regional AISA offices,

etc., in five provinces: Balkh, Faryab, Jowzjan, Sar-e-Pul and Samangan.[20] With the cooperation of the central government ministry offices (in particular the MoMP) and the regional institutions, it was possible to obtain sufficient data for the industrial, commercial and public sectors in the North Region. This process helped to create statistics for various sectors of activity and the number of the active enterprises in each sector. In turn, this approach helped to identify the major potential users of NG and their demand for NG.

4.2.3 Fertilizer Production and Power Generation Demand

The Fertilizer plant in Kod-e-Barq Mazar-e-Sharif was built by the former Soviet Union a half century ago. It had a design capacity of 200 Metric Tons (MT) per day of ammonia (through two lines of 100 MT/day) and 300 MT/day of urea (through three lines of 100 MT/day). The annual design production capacity of urea was 105,000 MT. In 1986 there was a sufficient supply of natural gas and the government decision to provide more than the designed supply (203 MMCM) to this plant for the production of 126,000 MT, exceeding its design capacity. Over time, however, based upon 2012 results, the annual production level has fallen to 25,000 MT based on a viable production capacity of 45,000 MT. Figure 21 presents the current production of the plant and its full capacity. With this information it is possible to estimate the unmet demand of natural gas as follows: the quantity of NG to supply the difference, in 2012, between the observed and full capacity production of the fertilizer plant, as presented in the following equations:

$$NGD_a = \frac{45{,}000}{f} - NGD_{2012}$$

Where:

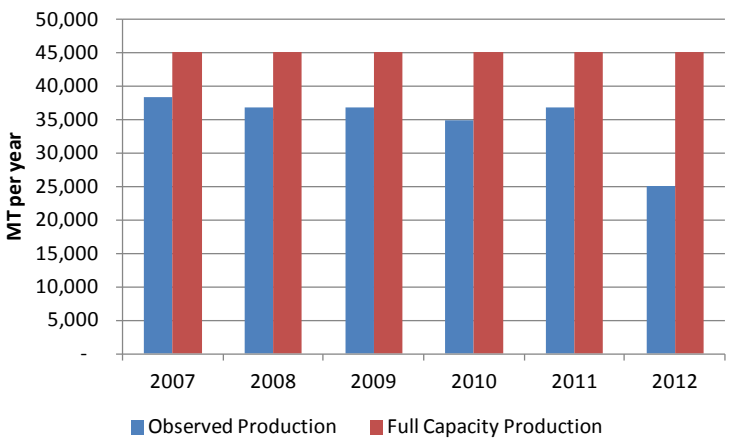
NGD_a = Additional Natural Gas Demand

f =Conversion factor 3,070

NGD_{2012} =Natural Gas Demand in 2012

The result is 6.51 MMCFD (184 MCMD) of NG. This report will utilize this number as the unmet demand of natural gas for the fertilizer plant and it will be constant during all the analyses.

Figure 21: Fertilizer Plant Production: Observed and Full Capacity



[20] For the rest of the regions, some official data and, also, an extrapolation (from the cities of the North) was made.

The Power Plant, in Kod-e-Barq-e Mazar-e-Sharif, was built to provide power with a capacity of 48 MW from four steam turbine generators of 12 MWs. The steam is supplied by five water tube boilers fueled by NG. Due to the power plant's degradation, the total current electricity production is only 12 MW, which satisfies the internal demand of the plant plus families working for the plant.

Regarding the future demand of NG for power generation, the report considers four scenarios:

1) Low Case, where there's only one plant with a 200 MW capacity, to be installed near[21] the gas fields in Sheberghan;
2) Case 1, where an additional to the plant in the "Low Case" scenario, another plant of 200 MWs will be built in Kabul;
3) Case 2, is similar to the Case 1, the only difference is that the new plant in Kabul will be of 400 MWs; and
4) Case 3 considers the generation of 600 MWs only in Sheberghan, in that sense, the difference between this case and the number two, is the energy transport, in the former case the system will include the transport of NG to Kabul, but in this case it will be electricity that is sent to Kabul on planned transmission lines.

Using the technical specifications of Table 25 for the power plants mentioned above, the necessary NG demand in each of the scenarios is presented in Figure 22.[22] As can be seen, this demand assumes that the plant operates at 50% capacity in year 1, 75% in year 2 and 100% from year 3. Also, another main assumption is that the relation between electricity production and NG demand is linear. It is expected that in the near future in Afghanistan the new power plants would involve multiple moderate size units rather than a few larger units, which may be more fuel efficient.

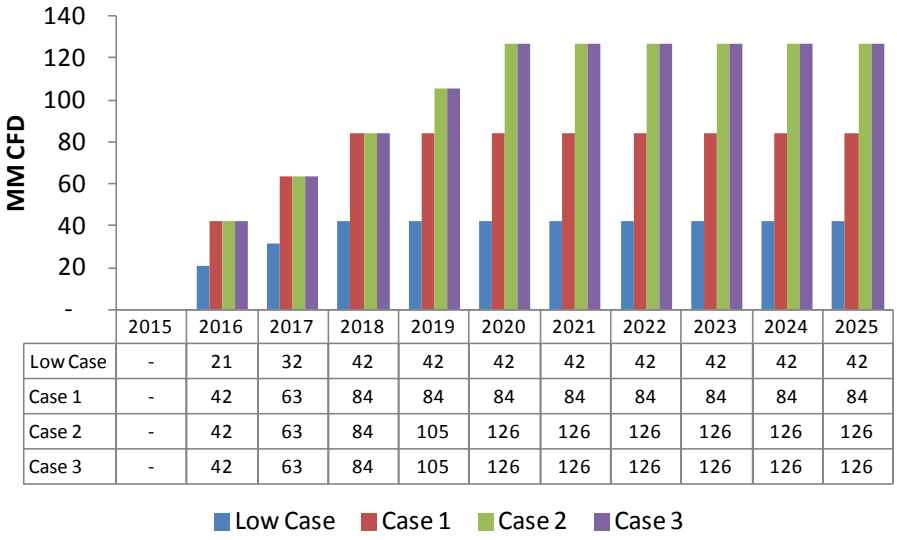
Table 25: Technical Specifications Power Plant

Concept	Unit	Value
Capacity Factor	%	85%
Hours/Year	Hours	8,760
Heat Rate	BTU/kWh	9,915
Heat Value Gas	BTU/CF	960

[21] The importance of the distance is that there is expected to be no additional, or at least minimum, natural gas transport charges.

[22] The projection exercise goes to year 2045 (that will be useful to calculate the transport and distribution tariffs), but for the purpose of the Report, only the period 2015-2025 will be considered.

Figure 22: NG Demand for Power Generation (MM CFD)



4.2.4 Industrial, Commercial and CNG Demand

In March 2013 some members of the SGGA visited the provinces in the North of the country: Balk, Jowzjan, Sar-e-Pul, Faryab and Samanyan, in order to obtain information about the energy consumption of the main industrial and commercial activities in the region. This section will use that collected information or extrapolated data to estimate the potential NG demand in the future. In particular, using energy equivalence factors, the amount of energy (in terms of NG) that these industries could demand by switching to NG can be estimated.

4.2.5 Industrial and Commercial Demand

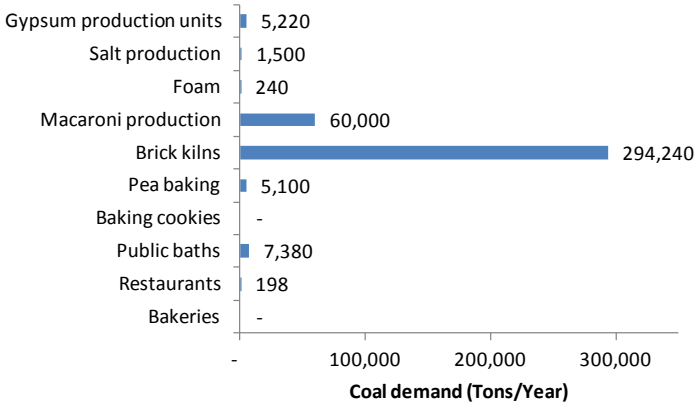
Table 26 presents the coal demand for the main industries and commercial activities in the 5 provinces. Presently, Balk province (including Mazar-e-Sharif) is the main user of this source of energy demand because of the brick kilns. In second place is Jowzjan (including Sheberghan) but with only 54,720 Tons of coal consumed per year. On the other hand, Figure 23 shows the coal demand by output product, and as mentioned before, brick production is the main user of this energy source. In second place is macaroni production.[23] The total demand of the five provinces is 373,878 Tons per year or about 1,024 Tons per day.

Table 26: Coal Demand for the Industrial and Commercial Sectors in the North - 2013 (Ton/Year)

Activity	Balk	Jawzjan	Sare Pul	Faryab	Samanyan	Total
Bakeries	-	-	-	-	-	-
Restaurants	-	-	64	-	134	198
Public baths	4,608	720	540	1,152	360	7,380
Baking cookies	-	-	-	-	-	-
Pea baking	4,500	-	-	600	-	5,100
Brick kilns	180,000	48,960	24,480	40,800	-	294,240
Macaroni production	60,000	-	-	-	-	60,000
Foam	240	-	-	-	-	240
Salt production	1,500	-	-	-	-	1,500
Gypsum production units	-	5,040	-	-	180	5,220
Total	**250,848**	**54,720**	**25,084**	**42,552**	**674**	**373,878**

[23] Also in Balk.

Figure 23: Total Coal Demand for the Industrial and Commercial Sectors in the North - 2013 (Ton/Year)

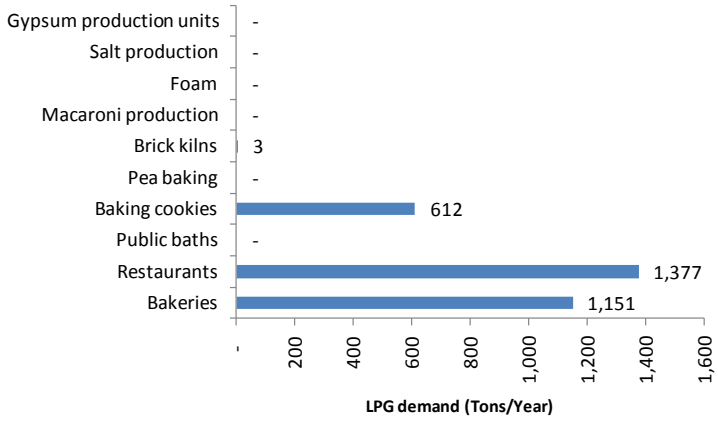


Regarding the demand for LPG, Table 27 presents the numbers for the five provinces, expressed in Tons per year in 2013. As expected, Balk is the main consumer of this energy source with 1,827 Ton/year. In second place are Faryab and, afterwards, Jowzjan. Due to the cleaner nature of LPG, the main user activities are related with cooking: restaurants, bakeries and baking cookies, see Figure 24.

Table 27: LPG Demand for the Industrial and Commercial Sectors in the North - 2013 (Ton/Year)

Activity	Balk	Jawzjan	Sare Pul	Faryab	Samanyan	Total
Bakeries	702	121	49	179	101	1,151
Restaurants	630	213	114	300	120	1,377
Public baths	-	-	-	-	-	-
Baking cookies	495	63	-	54	-	612
Pea baking	-	-	-	-	-	-
Brick kilns	-	-	-	3	-	3
Macaroni production	-	-	-	-	-	-
Foam	-	-	-	-	-	-
Salt production	-	-	-	-	-	-
Gypsum production units	-	-	-	-	-	-
Total	**1,827**	**397**	**163**	**536**	**221**	**3,144**

Figure 24: Total LPG Demand for the Industrial and Commercial Sectors in the North - 2013 (Ton/Year)



With the information described above it is possible to estimate the future expected demand for NG from the industrial and commercial activities for the regions subject to analysis: 1) Balk (Mazar-e-Sharif); 2) Jowzjan (Sheberghan); 3) Samangan; 4) Baghlan; 5) Kunduz; 6) Parwan (Charikar); and 7) Kabul.

In order to predict this demand, the following approach was used

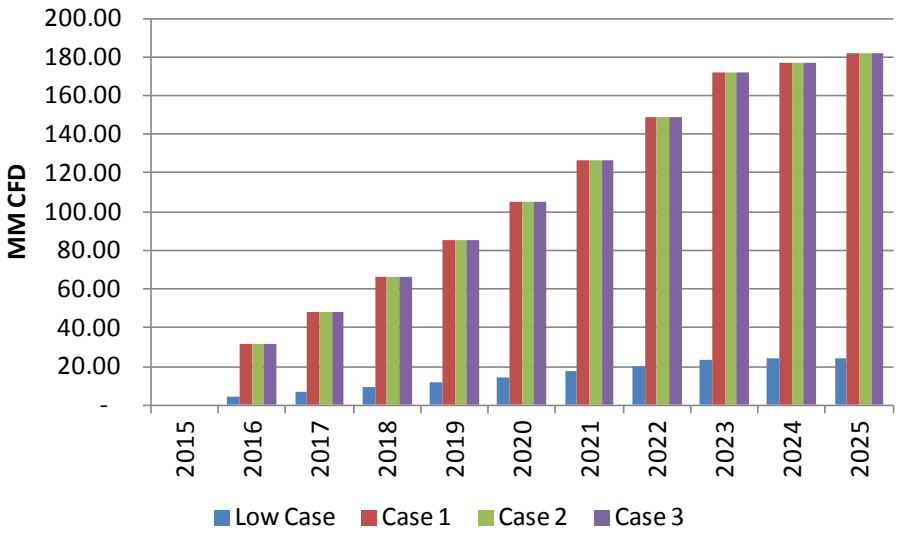
1) estimate the future demand of LPG and coal from the industrial and commercial sectors;[24]
2) multiple the projected volumes by the market share of coal and LPG;
3) convert the resulting volumes to natural gas equivalent, using the following conversion factors: 1 Kg of LPG = 47 CF of NG and 1 Ton of coal = 698 CM of NG.

For the Provinces that the SGGA staff could not visit, the demand was extrapolated using the number of urban households as criteria, see Table 23.

For LPG the market participation increases from 5% in 2017 to 45% in 2025; for coal from 20% in 2018 to 90% in 2025. The difference between these assumptions is that household changes in energy consumption are slower than business activities, because the cash availability for residents is assumed to be lower.

It is clear that the market in Sheberghan and Mazar-e-Sharif relative to Kabul is small, according to Figure 25, the difference between the Low Case and Cases 1, 2 and 3 is substantial and that is explained by the Kabul market, see Figure 26. On the other hand, clearly the main source of demand comes from the coal substitution and, as mentioned before, from the conversion of the brick factories in the Balk province, see Table 28. The LPG substitution doesn't have a great impact over the total demand, nevertheless, the social impact of this option is great and also the multiplier effect over the small factories is significant.

Figure 25: NG Demand by Industrial Sector (MM CFD)



[24] With the information for 2013, the rate of growth apply was the annual rate of growth for urban households in Provinces.

Figure 26: NG Demand by Industrial Sector - Case 2 and 3 - Year 2025

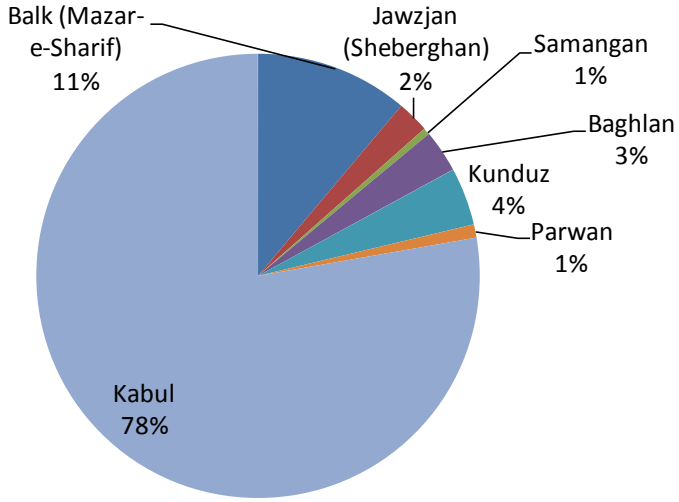


Table 28: NG Demand for Industrial and Commercial Uses (MM CFD)

Province (Urban)	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Balk (Mazar e Sharif)												
Coal	MM CFD	-	3.63	5.58	7.61	9.73	11.95	14.27	16.69	19.22	19.67	20.13
LPG	MM CFD	-	-	0.01	0.03	0.04	0.06	0.07	0.09	0.10	0.12	0.14
Jawzjan (Sheberghan)												
Coal	MM CFD	-	0.79	1.21	1.64	2.09	2.55	3.04	3.54	4.06	4.14	4.21
LPG	MM CFD	-	-	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.03
Samangan												
Coal	MM CFD	-	0.20	0.29	0.39	0.49	0.59	0.69	0.79	0.88	0.88	0.88
LPG	MM CFD	-	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
Baghlan												
Coal	MM CFD	-	1.05	1.61	2.19	2.78	3.40	4.04	4.70	5.39	5.49	5.59
LPG	MM CFD	-	-	0.00	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04
Kunduz												
Coal	MM CFD	-	1.39	2.12	2.89	3.70	4.54	5.41	6.32	7.26	7.42	7.58
LPG	MM CFD	-	-	0.00	0.01	0.02	0.02	0.03	0.03	0.04	0.05	0.05
Parwan (Charikar)												
Coal	MM CFD	-	0.39	0.59	0.79	0.98	1.18	1.38	1.57	1.77	1.77	1.77
LPG	MM CFD	-	-	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Kabul												
Coal	MM CFD	-	23.83	36.82	50.59	65.16	80.57	96.86	114.06	132.22	136.24	140.38
LPG	MM CFD	-	-	0.08	0.17	0.27	0.37	0.48	0.59	0.71	0.84	0.97
Total	**MM CFD**	**-**	**31.28**	**48.34**	**66.33**	**85.30**	**105.27**	**126.31**	**148.44**	**171.72**	**176.69**	**181.80**
Coal	MM CFD	-	31.28	48.23	66.10	84.94	104.79	125.68	147.67	170.80	175.61	180.55
LPG	MM CFD	-	-	0.11	0.23	0.35	0.48	0.62	0.77	0.92	1.08	1.25

4.2.6 CNG Demand

While CNG use in neighboring countries is in advanced stages, Afghanistan has newly started in this industry. It will be a new experience, allowing the country to reduce its energetic dependence from oil products, to protect environment and to create new economic opportunities in terms of growth and employment. In Afghanistan fuel importation is responsible of one third of trade balance deficit and the transport sector is one of the leading contributors to the current high pollution levels in major cities in Afghanistan.

In Afghanistan the development and expansion of CNG depends on the upstream and downstream development. There is a low level of the NG production due to the lack of NG infrastructure. The country currently has only one fuelling station of CNG in Sheberghan,[25] but promotion of CNG is expected in the future years with rehabilitation of NG fields and the increased availability of NG. Some individual initiatives were undertaken converting vehicles to use LPG as fuel, mainly for the potential

[25] Completed in March 2012.

cost savings over gasoline While CNG and LPG both are cleaner burning fuels and pollution reduction is one the goals for the Afghan environment, little progress has been made in this area.

The construction of the pilot CNG station in Sheberghan City, Jowzjan Province, was completed in March 2012 and the station is functioning. The pilot CNG station converts gas into CNG from a direct pipeline from Sheberghan gas fields and provides gas to car owners, as well as wholesale consumers. The first 100 passenger cars were already converted free of charge to use CNG. The real conversion cost per engine (from gasoline to CNG) is about US$800, however the current price for the final consumers is only 15,000 Afghanis (US$300) and the difference is supported by Afghan Government through subsidies. The price of 1Kg of CNG is US$ 0.65 while 1 liter of gasoline is US$ 1.1, as mentioned previously, the policy is to set the CNG price at more or less 70% of the gasoline price. By comparison, in average terms, outside of Afghanistan, the regional price of CNG is one half of the gasoline and a quarter of diesel prices.

The conversion equipment imported is designed for Toyota Corollas since these Japanese vehicles represent a substantial share of the national automobile fleet. The CNG fuel cylinders have a capacity of 12 Kg to provide between 160 and 170 Km of driving range. The converted vehicles have a longer driving range since the engine can also still use any stored gasoline. According to AGE, one Kg of CNG can run 16 Km while one liter of gasoline delivers 14 Km of travel distance. Therefore, these CNG cylinders can handle common short distance travel, for example, driving from Mazar-e-Sharif to Sheberghan. Also, the CNG station has started to provide CNG for the Afghan army's power generation equipment. Previously working with diesel, these power generators are now operating with 600 Kg CNG tanks to replace the 1,250 liter diesel tanks. According the current planning, the next step is providing CNG to Mazar-e-Sharif, and the first refueling stations in that city are expected during the summer of 2013.

Regarding the estimation of future demand for CNG, Table 29 presents the main assumptions used to project the demand on NG for this sector. First, the total number of gasoline vehicles is about 284,000[26] and a reasonable target is the conversion of 30% of the vehicles to CNG is over 15 years. It is also, assumed that the rate of vehicle growth will be at the same rate of the households growth. Regarding the individual demand, the following assumptions were made: each vehicle will refill 3 times per week, each daily fill is 7.5 Kg of CNG, and that pattern continues for 52 weeks per year.

Table 29: CNG Conversion Assumptions

Provinces	Urban Population	Growth of Population Households	Gasoline Vehicles	Target CNG Vehicles	Years
Balk (Mazar)	61%	2.3%	34,465	30%	15.00
Jawzjan (Sheberghan)	15%	1.9%	1,920	30%	15.00
Samanjan	4%	0.0%	388	30%	15.00
Baghlan	20%	1.8%	7,390	30%	15.00
Kunduz	25%	2.2%	10,602	30%	15.00
Parwan (Charikar)	9%	0.0%	935	30%	15.00
Kabul	84%	3.0%	228,631	30%	15.00
Total			284,331		

[26] The data available for this information was for Balk, Jawzjan, Samangan, Sar e Pul, Faryab and Kabul; then, to estimate the number of vehicles in Baghlan, Kunduz and Parwan, an econometric estimation was done. In that sense, the estimation equation is: $y = -3014.1 + 0.5068x$. Where "x" is the number of urban households and "y" is the number of gasoline vehicles.

With the foregoing assumptions it's possible to estimate the future demand for CNG. Table 30 presents the projected demand for CNG until 2025. As mentioned earlier, for economic analysis reasons the projection goes to 2045 but regarding the volumes, only the period 2015-2025 will be considered.[27] The data in the following table shows the same behavior as the industrial sector, once Kabul demand is included the volumes grow significantly, for example, in 2025 in the Low Case the total consumption is 1.34 MM CFD, but in Cases 1, 2 and 3, it is 11.12 MM CFD. This is based on the assumption that the regular growth of CNG cars will achieve 20% market share after 10 years, by 2025, on the path to 30% market share after 15 years.

Table 30: CNG Projected Demand

Scenarios	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Low Case												
Vehicles Gasoline	#	38,969	39,879	40,811	41,765	42,741	43,739	44,761	45,807	46,877	47,972	49,092
Vehicles CNG	#	-	798	1,632	2,506	3,419	4,374	5,371	6,413	7,500	8,635	9,818
NG Consumption	MM CFD	-	0.11	0.22	0.34	0.47	0.60	0.73	0.87	1.02	1.17	1.34
Case 1												
Vehicles Gasoline	#	309,506	318,400	327,556	336,979	346,677	356,658	366,932	377,507	388,391	399,594	411,124
Vehicles CNG	#	-	6,369	13,102	20,218	27,734	35,667	44,032	52,851	62,143	71,927	82,224
NG Consumption	MM CFD	-	0.87	1.78	2.75	3.77	4.85	5.99	7.19	8.46	9.79	11.19
Case 2												
Vehicles Gasoline	#	309,506	318,400	327,556	336,979	346,677	356,658	366,932	377,507	388,391	399,594	411,124
Vehicles CNG	#	-	6,369	13,102	20,218	27,734	35,667	44,032	52,851	62,143	71,927	82,224
NG Consumption	MM CFD	-	0.87	1.78	2.75	3.77	4.85	5.99	7.19	8.46	9.79	11.19
Case 3												
Vehicles Gasoline	#	309,506	318,400	327,556	336,979	346,677	356,658	366,932	377,507	388,391	399,594	411,124
Vehicles CNG	#	-	6,369	13,102	20,218	27,734	35,667	44,032	52,851	62,143	71,927	82,224
NG Consumption	MM CFD	-	0.87	1.78	2.75	3.77	4.85	5.99	7.19	8.46	9.79	11.19

4.2.7 Residential Use

The analysis of this section is based on the "The National Risk and Vulnerability Assessment (NRVA) 2007/8, which is a nationally representative multi-purpose survey, covering a variety of development sectors and cross-cutting themes, like poverty and the position of women. The survey was implemented by the Ministry of Rural Rehabilitation and Development and the CSO with financial support of the European Commission."[28] The following are the main features of the NRVA that are relevant to this Feasibility Report:

- The survey presents the information of 20,576 households over the entire country.
- The segmentation of the households are based on provinces, nevertheless, some information exists for districts.[29]
- The survey was made in 2007 and considers a population of 24,969,900 in 3,437,928 households.[30]
- The applicable questions from this report are:[31]
  - In the past 30 days, what has been the household's main source of lighting? Question 2.22
  - In the past 30 days, what has been the household's main source of cooking fuel? Question 2.23[32]
  - What is the main source of heating for this house in winter? Question 2.24
  - How much did this household spend in the last month for each type of fuel used in the household? Question 2.25

[27] A detail of these calculations can be found in Annex 2.
[28] http://cso.gov.af/en/page/1726
[29] See Annex 3 for a detail tables of the provinces and districts.
[30] These numbers are the expansion factors suggested.
[31] See Annex 4 for a copy of the specific section of the Survey.
[32] Unfortunately the survey doesn't distinguish between NG by network (as the case of Sheberghan) and the LPG, it was assumed that all the answers in the survey were related to the LPG consumption, because the survey reports the price of "gas", which is close related with the price of LPG.

The MATLAB code that was applied in order to use the information from NRVA is presented in Annex 5. It was necessary to use MATLAB to manage the vast quantity of data.

4.2.8 Energy Demand for Cooking, Heating and Lighting

This section presents the main results of the household analysis regarding the type of fuel use for cooking, heating and lighting in the Provinces. In particular, it will show the percentage of families that used a specific source of energy for each of the activities. As previously indicated, the primary information source to extrapolate this data was the answers to Questions 2.22, 2.23 and 2.24 of the NRVA survey.

The Table 31 presents the percentage of households in Afghanistan that use a specific source of energy for cooking. According to this table, 35% of families use bushes/twigs and branches for this activity, while the other significant energy sources include the animal dung, 24%, and the firewood, 20%. However, these results are the aggregated amounts between rural and urban consumers. Due to the comparatively high cost to benefit ratio of delivering NG to rural consumers, the following extrapolation of users instead focuses on the high density urban areas. That approach is reasonable since almost 68% of the families in the urban area use gas to cook and, in a distant second place are the families that use firewood (17%). Given the rate of return expectations to develop the NG system, it is important to focus on the more achievable targets first and consider secondary targets when supported by appropriate system profits.

Table 31: Energy Use for Cooking in Afghanistan - % of Households (2007)

Concept	Rural	Urban	Total
Animal dung	28%	5%	24%
Bushes (ping)/ twigs, branches	42%	5%	35%
Crop residues	2%	0%	2%
Firewood	22%	17%	20%
Charcoal/coal	0%	1%	1%
Kerosene or oil	0%	1%	0%
Gas	4%	68%	16%
Electricity	0%	1%	0%
Scavenged material	1%	1%	1%
Other	0%	0%	0%

Source: NRVA Survey 2007

Elaboration: Own

The Table 32 shows the percentage of families that use each source of energy to cook in the Provinces.[33] From this table it's possible to make the following observations:

1) The urban region consumers in Balk (where Mazar-e-Sharif is important) mainly use gas (57%) and firewood (20%);
2) The urban region consumers in Jowzjan (Sheberghan city) use animal dung (42%) and bushes/twigs and branches (30%), so the use of gas is comparatively low (18%);[34]
3) The other provinces of the North are mainly rural areas, which is statistically apparent since the main sources of energy to cook are bushes/twigs and branches, and animal dung;
4) It is noteworthy that most of the households in the urban area in Kabul use gas (81%) while in the surrounding rural regions the families primarily use firewood (60%).

[33] This region (the North) is important for the current report because it will be the principal market, in the short term, for the NG production from Sheberghan.

[34] In fact, with the information in the survey is not possible to determine in this area if this "gas" is LPG or NG. For the purpose of this Report, it will be assume that, in this case, is LPG.

On the basis of this information, in the short term one of the attractive markets for the NG from the Sheberghan area would be the city of Mazar-e-Sharif. In the long term, the city of Kabul, with its large population of customers would be the next target. Of course, to address the long term target it will be necessary to develop a new, economically supportable, transport system from the North to Kabul.

The city of Mazar-e-Sharif will benefit from the repair of the pipeline from Sheberghan and the possible construction of another parallel pipeline as well by the TFBSO. However, due to the age and poor quality of the existing distribution systems in Sheberghan and Mazar, the SGGA cost analysis assumes that all other NG infrastructure will be replaced by new distribution systems. This is the Low Case scenario.

To be economically supportable, the pipeline and the individual distribution systems along the way to Kabul must produce an acceptable rate of return. This requirement underpins the other scenarios: "Cases 1, 2 and 3".

Table 32: Energy Use for Cooking in the North and Kabul - % of Households (2007)

Use of Energy for Cooking Balk (% of Households) 1

Concept	Rural	Urban	Total
Animal dung	41%	9%	32%
Bushes (ping)/ twigs, branches	42%	6%	29%
Crop residues	3%	0%	2%
Firewood	6%	20%	10%
Charcoal/coal	0%	2%	1%
Kerosene or oil	0%	2%	1%
Gas	4%	57%	21%
Electricity	1%	0%	1%
Scavenged material	3%	4%	3%
Other	0%	0%	0%

Source: NRVA Survey 2007
Elaboration: Own

Use of Energy for Cooking Jawzjan (% of Households) 2

Concept	Rural	Urban	Total
Animal dung	58%	42%	55%
Bushes (ping)/ twigs, branches	36%	30%	35%
Crop residues	0%	0%	0%
Firewood	3%	8%	4%
Charcoal/coal	0%	1%	0%
Kerosene or oil	0%	0%	0%
Gas	3%	18%	6%
Electricity	0%	0%	0%
Scavenged material	0%	0%	0%
Other	0%	0%	0%

Source: NRVA Survey 2007
Elaboration: Own

Use of Energy for Cooking Samangan (% of Households) 3

Concept	Rural	Urban	Total
Animal dung	26%	N/A	26%
Bushes (ping)/ twigs, branches	64%	N/A	64%
Crop residues	4%	N/A	4%
Firewood	1%	N/A	1%
Charcoal/coal	1%	N/A	1%
Kerosene or oil	0%	N/A	0%
Gas	2%	N/A	2%
Electricity	0%	N/A	0%
Scavenged material	0%	N/A	0%
Other	0%	N/A	0%

Source: NRVA Survey 2007
Elaboration: Own

Use of Energy for Cooking Baghlam (% of Households) 4

Concept	Rural	Urban	Total
Animal dung	39%	11%	33%
Bushes (ping)/ twigs, branches	30%	7%	26%
Crop residues	3%	3%	3%
Firewood	19%	37%	23%
Charcoal/coal	1%	1%	1%
Kerosene or oil	0%	0%	0%
Gas	2%	33%	8%
Electricity	0%	3%	0%
Scavenged material	1%	4%	1%
Other	4%	1%	4%

Source: NRVA Survey 2007
Elaboration: Own

Use of Energy for Cooking Kunduz (% of Households) 5

Concept	Rural	Urban	Total
Animal dung	31%	7%	27%
Bushes (ping)/ twigs, branches	45%	14%	38%
Crop residues	8%	1%	6%
Firewood	14%	43%	19%
Charcoal/coal	0%	0%	1%
Kerosene or oil	0%	1%	0%
N/A	2%	31%	8%
Electricity	0%	0%	0%
Scavenged material	0%	1%	0%
Other	0%	1%	0%

Source: NRVA Survey 2007
Elaboration: Own

Use of Energy for Cooking Parwan (% of Households) 6

Concept	Rural	Urban	Total
Animal dung	2%	N/A	3%
Bushes (ping)/ twigs, branches	7%	N/A	11%
Crop residues	0%	N/A	0%
Firewood	84%	N/A	79%
Charcoal/coal	1%	N/A	0%
Kerosene or oil	0%	N/A	0%
Gas	6%	N/A	6%
Electricity	0%	N/A	0%
Scavenged material	0%	N/A	0%
Other	0%	N/A	0%

Source: NRVA Survey 2007
Elaboration: Own

Use of Energy for Cooking Kabul (% of Households) 7

Concept	Rural	Urban	Total
Animal dung	4%	0%	2%
Bushes (ping)/ twigs, branches	13%	0%	3%
Crop residues	0%	0%	0%
Firewood	60%	14%	22%
Charcoal/coal	1%	2%	2%
Kerosene or oil	0%	1%	1%
Gas	17%	81%	69%
Electricity	2%	0%	1%
Scavenged material	1%	0%	1%
Other	0%	0%	0%

Source: NRVA Survey 2007
Elaboration: Own

Regarding the source of energy use for heating, Table 33 presents the situation for the whole country in total and segmented by rural and urban. It's quite interesting to see that, even in urban areas, firewood is the most important source of energy, in second place straw, bushes/twigs and manure and, in third place charcoal. Of course, the main hypothesis behind these results is that most of the families in the country can't afford any electric or LPG appliance to heat their home. For that reason, they

use the source of energy compatible with their economic constraints. As may expected, and as obvious from Table 34, the situation in the Provinces is not much different than in Kabul. The use of the mentioned sources of energy for heating are common practice in the country, however, NG could be an option for the families in the medium and long term.

Table 33: Energy Use for Heating in Afghanistan - % of Households (2007)

Concept	Rural	Urban	Total
No heating in house	1%	2%	2%
Electricity	1%	4%	1%
Gas	1%	3%	1%
Kerosene/Diesel/Petrol	0%	0%	0%
Firewood	42%	53%	43%
Charcoal	5%	23%	9%
Coal	2%	4%	2%
Straw, bushes/twigs , manure	47%	8%	40%
Scavenged materials/ trash	1%	1%	1%
Chem	0%	0%	0%
Other	1%	2%	1%

Source: NRVA Survey 2007

Elaboration: Own

Table 34: Energy Use for Heating in the North and Kabul - % of Households (2007)

Use of Energy for Heating Balk (% of Households) 1

Concept	Rural	Urban	Total
No heating in house	0%	0%	0%
Electricity	0%	1%	1%
Gas	0%	2%	1%
Kerosene/Diesel/Petrol	0%	0%	0%
Firewood	12%	23%	15%
Charcoal	3%	45%	17%
Coal	2%	9%	4%
Straw, bushes/twigs , manure	80%	16%	59%
Scavenged materials/ trash	2%	2%	2%
Chem	0%	0%	0%

Source: NRVA Survey 2007
Elaboration: Own

Use of Energy for Heating Jawzjan (% of Households) 2

Concept	Rural	Urban	Total
No heating in house	0%	0%	0%
Electricity	0%	0%	0%
Gas	2%	5%	3%
Kerosene/Diesel/Petrol	0%	0%	0%
Firewood	27%	46%	31%
Charcoal	0%	1%	0%
Coal	0%	0%	0%
Straw, bushes/twigs , manure	70%	48%	66%
Scavenged materials/ trash	0%	0%	0%
Chem	0%	0%	0%

Source: NRVA Survey 2007
Elaboration: Own

Use of Energy for Heating Samangan (% of Households) 3

Concept	Rural	Urban	Total
No heating in house	0%	N/A	0%
Electricity	0%	N/A	0%
Gas	0%	N/A	0%
Kerosene/Diesel/Petrol	0%	N/A	0%
Firewood	13%	N/A	13%
Charcoal	3%	N/A	3%
Coal	24%	N/A	24%
Straw, bushes/twigs , manure	59%	N/A	59%
Scavenged materials/ trash	0%	N/A	0%
Chem	0%	N/A	0%

Source: NRVA Survey 2007
Elaboration: Own

Use of Energy for Heating Baghlam (% of Households) 4

Concept	Rural	Urban	Total
No heating in house	0%	1%	0%
Electricity	0%	2%	0%
Gas	0%	0%	0%
Kerosene/Diesel/Petrol	1%	0%	1%
Firewood	33%	15%	30%
Charcoal	0%	2%	1%
Coal	14%	74%	24%
Straw, bushes/twigs , manure	51%	4%	43%
Scavenged materials/ trash	0%	0%	0%
Chem	0%	0%	0%

Source: NRVA Survey 2007
Elaboration: Own

Use of Energy for Heating Kunduz (% of Households) 5

Concept	Rural	Urban	Total
No heating in house	0%	0%	0%
Electricity	0%	0%	0%
Gas	0%	0%	0%
Kerosene/Diesel/Petrol	0%	0%	0%
Firewood	29%	63%	35%
Charcoal	3%	13%	5%
Coal	2%	9%	3%
Straw, bushes/twigs , manure	66%	14%	56%
Scavenged materials/ trash	0%	0%	0%
Chem	0%	0%	0%

Source: NRVA Survey 2007
Elaboration: Own

Use of Energy for Heating Parwan (% of Households) 6

Concept	Rural	Urban	Total
No heating in house	0%	N/A	0%
Electricity	0%	N/A	0%
Gas	0%	N/A	0%
Kerosene/Diesel/Petrol	0%	N/A	0%
Firewood	39%	N/A	36%
Charcoal	52%	N/A	49%
Coal	1%	N/A	1%
Straw, bushes/twigs , manure	8%	N/A	13%
Scavenged materials/ trash	0%	N/A	0%
Chem	0%	N/A	0%

Source: NRVA Survey 2007
Elaboration: Own

Use of Energy for Heating Kabul (% of Households) 7

Concept	Rural	Urban	Total
Animal dung	0%	0%	1%
Bushes (ping)/ twigs, branches	1%	0%	0%
Crop residues	0%	3%	2%
Firewood	0%	0%	0%
Charcoal/coal	43%	73%	67%
Kerosene or oil	45%	19%	23%
Gas	1%	1%	1%
Electricity	10%	0%	2%
Scavenged material	0%	0%	0%
Other	0%	0%	0%

Source: NRVA Survey 2007
Elaboration: Own

Regarding the type of energy to provide lighting, the situation is different among the rural and urban areas. Table 35 shows that 68% of the families in the rural area use oil lamps and 18% have power from an electric generator. On the other hand, 68% of the urban families use electricity from the grid, 14% use oil lamps and 10% use power from an electric generator. Using this information as an indication of the access to electricity in Afghanistan, it can be seen that 33% of the families (in 2007)

had access to electricity from the grid or a generator, 59% had oil lamps and 8% used other sources. In that sense, according NRVA survey, the access to electricity in the country is still very low.

Table 35: Energy Use for Lighting in Afghanistan - % of Households (2007)

Concept	Rural	Urban	Total
None	0%	0%	0%
Oil Lamp	68%	14%	59%
Candles	0%	0%	0%
Electricity from grid	5%	68%	18%
Generator	18%	10%	15%
Battery	1%	1%	1%
Gas	3%	6%	3%
Firewood	0%	0%	0%
Other	4%	1%	4%

Source: NRVA Survey 2007

Elaboration: Own

The following Table 36 presents the sources of energy for lighting in the Provinces and, as in previous sections, the most important market areas outside Kabul are Balk and Jowzjan provinces because the production of NG will come from the fields in Sheberghan. It's quite interesting to note that the families in the urban areas in the provinces use electricity from the grid, 64% in Mazar-e-Sharif and 89% in Sheberghan, while the second source of energy is from oil lamps. So the Sheberghan Gas to Power Project should have good opportunity to sell electricity for lighting in this region.

In the rest of the Provinces the main source for lighting is the oil lamps, probably because there's no reliable and affordable electricity in these areas. However, in the medium and long term, there could be reliable and affordable electricity in these provinces. Finally, it can be observed that 74% of the families in Kabul use electricity from grid for lighting and 13% use power from an electric generator. On the other hand, 37% of the families in the rural areas of Kabul use oil lamps, while 25% get lighting from using an electric generator, 17% have electricity from grid, and 16% use gas.

Table 36: Energy Use for Lighting in the North and Kabul - % of Households (2007)

Use of Energy for Lighting Balk (% of Households) 1

Concept	Rural	Urban	Total
None	0%	0%	0%
Oil Lamp	73%	31%	59%
Candles	0%	0%	0%
Electricity from grid	15%	64%	31%
Generator	11%	1%	8%
Battery	0%	1%	0%
Gas	0%	4%	1%
Firewood	0%	0%	0%
Other	1%	0%	1%

Source: NRVA Survey 2007

Elaboration: Own

Use of Energy for Lighting Jawzjan (% of Households) 2

Concept	Rural	Urban	Total
None	1%	0%	1%
Oil Lamp	68%	6%	56%
Candles	0%	0%	0%
Electricity from grid	25%	89%	37%
Generator	6%	4%	6%
Battery	0%	0%	0%
Gas	0%	1%	0%
Firewood	0%	0%	0%
Other	0%	0%	0%

Source: NRVA Survey 2007

Elaboration: Own

Use of Energy for Lighting Samangan (% of Households) 3

Concept	Rural	Urban	Total
None	0%	N/A	0%
Oil Lamp	73%	N/A	73%
Candles	0%	N/A	0%
Electricity from grid	8%	N/A	8%
Generator	15%	N/A	15%
Battery	0%	N/A	0%
Gas	0%	N/A	0%
Firewood	0%	N/A	0%
Other	4%	N/A	4%

Source: NRVA Survey 2007

Elaboration: Own

Use of Energy for Lighting Baghlam (% of Households) 4

Concept	Rural	Urban	Total
None	0%	0%	0%
Oil Lamp	77%	53%	73%
Candles	0%	0%	0%
Electricity from grid	1%	22%	5%
Generator	16%	9%	14%
Battery	0%	1%	0%
Gas	3%	14%	5%
Firewood	0%	0%	0%
Other	3%	0%	2%

Source: NRVA Survey 2007

Elaboration: Own

Use of Energy for Lighting Kunduz (% of Households) 5

Concept	Rural	Urban	Total
None	0%	0%	0%
Oil Lamp	78%	27%	69%
Candles	0%	0%	0%
Electricity from grid	6%	51%	14%
Generator	11%	10%	10%
Battery	0%	0%	0%
Gas	3%	10%	5%
Firewood	0%	0%	0%
Other	2%	2%	2%

Source: NRVA Survey 2007

Elaboration: Own

Use of Energy for Lighting Parwan (% of Households) 6

Concept	Rural	Urban	Total
None	0%	N/A	0%
Oil Lamp	44%	N/A	47%
Candles	0%	N/A	0%
Electricity from grid	4%	N/A	4%
Generator	23%	N/A	21%
Battery	0%	N/A	0%
Gas	18%	N/A	18%
Firewood	0%	N/A	0%
Other	11%	N/A	10%

Source: NRVA Survey 2007

Elaboration: Own

Use of Energy for Lighting Kabul (% of Households) 7

Concept	Rural	Urban	Total
None	0%	0%	0%
Oil Lamp	37%	3%	10%
Candles	0%	0%	0%
Electricity from grid	17%	74%	63%
Generator	25%	13%	15%
Battery	2%	2%	2%
Gas	16%	6%	8%
Firewood	0%	0%	0%
Other	4%	2%	2%

Source: NRVA Survey 2007

Elaboration: Own

4.2.9 Energy Expenditures

This section will present the main results regarding the amount of money used by Afghan families to pay for specific sources of energy. The source data in the following tables are the answers to Question 2.25 of the NRVA survey. Also, it is important to note that the primary information was in Afghanis and the rate of exchange applied to convert this information to US$ was 49.96 AFN/US$.

Table 37 presents the total monthly expenditure by household by type of energy in 2007 US$. At the national level, several features can be observed from this data: 1) the average monthly expenditures for gas by each family is US$4.07, with US$11 average in the urban area and US$2.45 average in the rural areas; 2) for electricity the monthly expenditure is US$2.5 , with US$7.7 average in urban areas and US$1.26 average in rural areas; and 3) the expenditure for firewood is one of the biggest in the sample, US$6.2 in total, US$10.1 average in the urban areas and US$5.4 average in rural areas.

Table 37: Monthly Expenditure in Energy by Household - Afghanistan (US$ 2007)

Concept	Electricity	Gas	Fuel Oil	Firewood	Charcoal	Coal	Straw, ping, manure
Total							
Mean	2.49	4.07	3.62	6.20	0.39	0.21	2.21
Standard Deviation	5.53	6.75	4.97	13.50	2.51	2.63	7.66
Max.	140.11	160.13	192.15	180.14	60.05	160.13	180.14
Min.	-	-	-	-	-	-	-
Urban							
Mean	7.74	11.01	2.41	10.05	1.05	0.45	1.10
Standard Deviation	8.39	8.91	6.75	18.43	3.89	3.52	5.09
Max.	140.11	160.13	178.14	160.13	60.05	120.10	180.14
Min.	-	-	-	-	-	-	-
Rural							
Mean	1.26	2.45	3.89	5.43	0.24	0.16	2.48
Standard Deviation	3.57	4.81	4.41	11.97	2.07	2.43	8.10
Max.	120.10	160.13	192.15	180.14	42.03	160.13	180.14
Min.	-	-	-	-	-	-	-

Source: NRVA Survey 2007

Elaboration: Own

Regarding the situation of the Provinces, the following tables, 38 – 44, present some interesting results that could help to understand better the energy situation in the Provinces:

The monthly average expenditure[35] for gas[36] in the urban areas was: US$6.61 in Balk (Mazar), US$7.63 in Jowzjan (Sheberghan), US$1.2 in Samangan,[37] US$8.25 in Baghlan, US$7.29 in Kunduz, US$5.41 in Parwan and US$13.1 in Kabul.

The monthly average expenditure[38] in gas in the rural areas was: US$ 0.51 in Balk (Mazar), US$1.69 in Jowzjan (Sheberghan), US$1.2 in Samangan, US$2.22 in Baghlan, US$1.27 in Kunduz, US$5.41 in Parwan and US$6.53 in Kabul.

The highest expenditures for energy in urban areas were: gas (US$6.61) in Balk, firewood (US$12.55) in Jowzjan, fuel oil (US$4.48) in Samangan, firewood (US$11.81) in Baghlan, firewood (US$9.39) in Kunduz, firewood (US$16.82) in Parwan and firewood (US$13.1) in Kabul.

The highest monthly expenditures for energy in rural areas were: fuel oil (US$4.11) in Balk, firewood (US$5.89) in Jowzjan, fuel oil (US$4.48) in Samangan, firewood (US$5.44) in Baghlan, fuel oil (US$3.51) in Kunduz, firewood (US$16.82) in Parwan and firewood (US$14.5) in Kabul.

[35] In US$ of 2007-2008.
[36] This information is important because NG could replace the consumption of LPG.
[37] In this case is related to the rural area.
[38] In US$ of 2007-2008.

Table 38: Monthly Expenditure in Energy by Household - Balk (US$ 2007)

Concept	Electricity	Gas	Fuel Oil	Firewood	Charcoal	Coal	Straw, ping, manure
Total							
Mean	3.21	2.53	3.33	2.28	0.54	0.34	4.15
Standard Deviation	5.27	4.60	5.27	7.08	2.22	1.99	8.10
Max.	60.05	36.03	126.10	120.10	30.02	20.02	100.08
Min.	-	-	-	-	-	-	-
Urban							
Mean	6.44	6.61	1.74	4.02	1.57	0.90	2.18
Standard Deviation	7.22	5.70	2.33	7.82	3.60	3.18	5.21
Max.	60.05	36.03	16.01	64.05	30.02	20.02	40.03
Min.	-	-	-	-	-	-	-
Rural							
Mean	1.65	0.54	4.11	1.47	0.03	0.08	4.78
Standard Deviation	2.89	1.85	6.14	6.61	0.44	0.84	7.82
Max.	20.02	14.01	126.10	120.10	8.01	14.01	80.06
Min.	-	-	-	-	-	-	-

Source: NRVA Survey 2007

Elaboration: Own

Table 39: Monthly Expenditure in Energy by Household - Jowzjan (US$ 2007)

Concept	Electricity	Gas	Fuel Oil	Firewood	Charcoal	Coal	Straw, ping, manure
Total							
Mean	2.46	2.83	4.28	7.17	0.04	-	14.44
Standard Deviation	3.83	5.53	4.68	14.12	0.91	-	11.47
Max.	40.03	40.03	46.04	140.11	30.02	-	180.14
Min.	-	-	-	-	-	-	-
Urban							
Mean	6.87	7.63	1.16	12.55	0.13	-	16.31
Standard Deviation	5.20	6.76	2.20	17.80	1.93	-	13.65
Max.	40.03	39.03	9.01	100.08	30.02	-	180.14
Min.	-	-	-	-	-	-	-
Rural							
Mean	1.41	1.69	5.01	5.89	0.02	-	13.99
Standard Deviation	2.45	4.51	4.81	12.77	0.37	-	10.84
Max.	12.01	40.03	46.04	140.11	6.00	-	50.04
Min.	-	-	-	-	-	-	-

Source: NRVA Survey 2007

Elaboration: Own

Table 40: Monthly Expenditure in Energy by Household - Samangan (US$ 2007)

Concept	Electricity	Gas	Fuel Oil	Firewood	Charcoal	Coal	Straw, ping, manure
Total							
Mean	2.07	1.20	4.48	1.61	0.03	0.92	3.18
Standard Deviation	4.32	3.37	2.88	7.98	0.52	4.97	6.86
Max.	32.03	32.03	18.01	100.08	10.01	64.05	40.03
Min.	-	-	-	-	-	-	-
Urban							
Mean	-	-	-	-	-	-	-
Standard Deviation	-	-	-	-	-	-	-
Max.	-	-	-	-	-	-	-
Min.	-	-	-	-	-	-	-
Rural							
Mean	2.07	1.20	4.48	1.61	0.03	0.92	3.18
Standard Deviation	4.32	3.37	2.88	7.98	0.52	4.97	6.86
Max.	32.03	32.03	18.01	100.08	10.01	64.05	40.03
Min.	-	-	-	-	-	-	-

Source: NRVA Survey 2007

Elaboration: Own

Table 41: Monthly Expenditure in Energy by Household - Baghlan (US$ 2007)

Concept	Electricity	Gas	Fuel Oil	Firewood	Charcoal	Coal	Straw, ping, manure
Total							
Mean	1.31	3.23	4.43	6.42	0.09	2.36	3.83
Standard Deviation	4.39	5.76	5.08	15.44	1.41	7.52	11.61
Max.	52.24	42.03	58.05	160.13	30.02	80.32	180.14
Min.	-	-	-	-	-	-	-
Urban							
Mean	3.59	8.25	3.57	11.81	0.22	6.66	3.14
Standard Deviation	6.02	8.67	4.68	17.04	2.33	12.67	7.22
Max.	40.03	42.03	40.03	106.75	30.02	80.32	40.03
Min.	-	-	-	-	-	-	-
Rural							
Mean	0.84	2.22	4.66	5.44	6.71E-02	1.49	4.11
Standard Deviation	3.84	4.24	5.22	15.04	1.14	5.50	12.53
Max.	52.24	24.02	58.05	160.13	24.02	51.36	180.14
Min.	-	-	-	-	-	-	-

Source: NRVA Survey 2007

Elaboration: Own

Table 42: Monthly Expenditure in Energy by Household - Kunduz (US$ 2007)

Concept	Electricity	Gas	Fuel Oil	Firewood	Charcoal	Coal	Straw, ping, manure
Total							
Mean	1.92	2.58	3.37	3.50	0.14	0.55	0.63
Standard Deviation	5.12	5.32	3.68	8.59	1.20	6.53	3.55
Max.	100.08	40.03	44.04	64.05	16.01	160.13	60.05
Min.	-	-	-	-	-	-	-
Urban							
Mean	6.40	7.29	2.37	9.39	0.23	1.05	0.50
Standard Deviation	9.26	7.95	4.80	12.72	1.49	3.74	2.71
Max.	100.08	40.03	44.04	64.05	14.01	30.02	30.02
Min.	-	-	-	-	-	-	-
Rural							
Mean	0.85	1.27	3.51	1.93	0.11	0.39	0.70
Standard Deviation	2.22	2.88	3.05	6.28	1.09	7.37	3.88
Max.	16.01	22.02	36.03	60.05	16.01	160.13	60.05
Min.	-	-	-	-	-	-	-

Source: NRVA Survey 2007

Elaboration: Own

Table 43: Monthly Expenditure in Energy by Household - Parwan (US$ 2007)

Concept	Electricity	Gas	Fuel Oil	Firewood	Charcoal	Coal	Straw, ping, manure
Total							
Mean	0.92	5.41	4.69	16.24	1.92	0.50	2.79
Standard Deviation	2.52	5.80	3.77	16.17	5.68	3.17	9.50
Max.	24.02	40.03	60.05	180.14	32.03	30.02	100.08
Min.	-	-	-	-	-	-	-
Urban							
Mean	-	-	-	-	-	-	-
Standard Deviation	-	-	-	-	-	-	-
Max.	-	-	-	-	-	-	-
Min.	-	-	-	-	-	-	-
Rural							
Mean	0.97	5.44	4.65	16.82	1.99	0.53	2.24
Standard Deviation	2.58	5.48	3.86	16.07	5.79	3.25	8.32
Max.	24.02	40.03	60.05	180.14	32.03	30.02	100.08
Min.	-	-	-	-	-	-	-

Source: NRVA Survey 2007

Elaboration: Own

Table 44: Monthly Expenditure in Energy by Household - Kabul (US$ 2007)

Concept	Electricity	Gas	Fuel Oil	Firewood	Charcoal	Coal	Straw, ping, manure
Total							
Mean	7.28	11.87	2.72	13.25	1.66	0.13	0.33
Standard Deviation	7.83	9.06	7.01	20.17	5.18	1.55	2.63
Max.	100.08	160.13	178.14	160.13	60.05	30.02	60.05
Min.	-	-	-	-	-	-	-
Urban							
Mean	8.26	13.10	2.40	13.10	1.39	0.14	0.03
Standard Deviation	7.87	8.91	7.53	21.12	4.67	1.67	0.90
Max.	100.08	160.13	178.14	160.13	60.05	30.02	30.02
Min.	-	-	-	-	-	-	-
Rural							
Mean	2.80	6.53	4.16	14.50	3.19	0.04	1.71
Standard Deviation	5.87	7.64	3.34	14.85	7.19	0.73	5.78
Max.	40.03	80.06	30.02	80.06	42.03	14.01	60.05
Min.	-	-	-	-	-	-	-

Source: NRVA Survey 2007

Elaboration: Own

4.2.10 LPG Demand

The NRVA Survey also provides information about available prices of goods and services inside the questionnaires, which fortunately also includes the LPG price for all the regions covered by the survey. So, by dividing LPG expenditures by the LPG prices, it's possible to find the LPG quantity demanded by the families in the survey. Since LPG is the principal substitute for NG, it's then possible to estimate the potential demand for NG by analyzing the LPG demand. This section will show the main findings regarding this topic.[39]

It is useful to start the analysis by looking at the LPG prices inside the survey. Figure 27 presents this information for the 34 provinces in the country. As may be expected the variance is high,[40] the lowest price is in Nimroz (US$0.98/Kg) and the highest one is in Daykundi (US$1.69/Kg). In the provinces of the North that are the subject of this report, the prices are between US$1.24 and US$1.36/Kg and in Kabul US$1.18/Kg. Finally, the average for all the country is US$1.30/Kg with a standard deviation of 0.16.

[39] As mentioned before, the programming code used to obtain these results can be found in the Annex 6.

[40] Since, for example, the transport costs inside the country will vary by distance and other factors.

Figure 27: LPG prices in NRVA Survey 2007 - 2008 (US$/Kg)

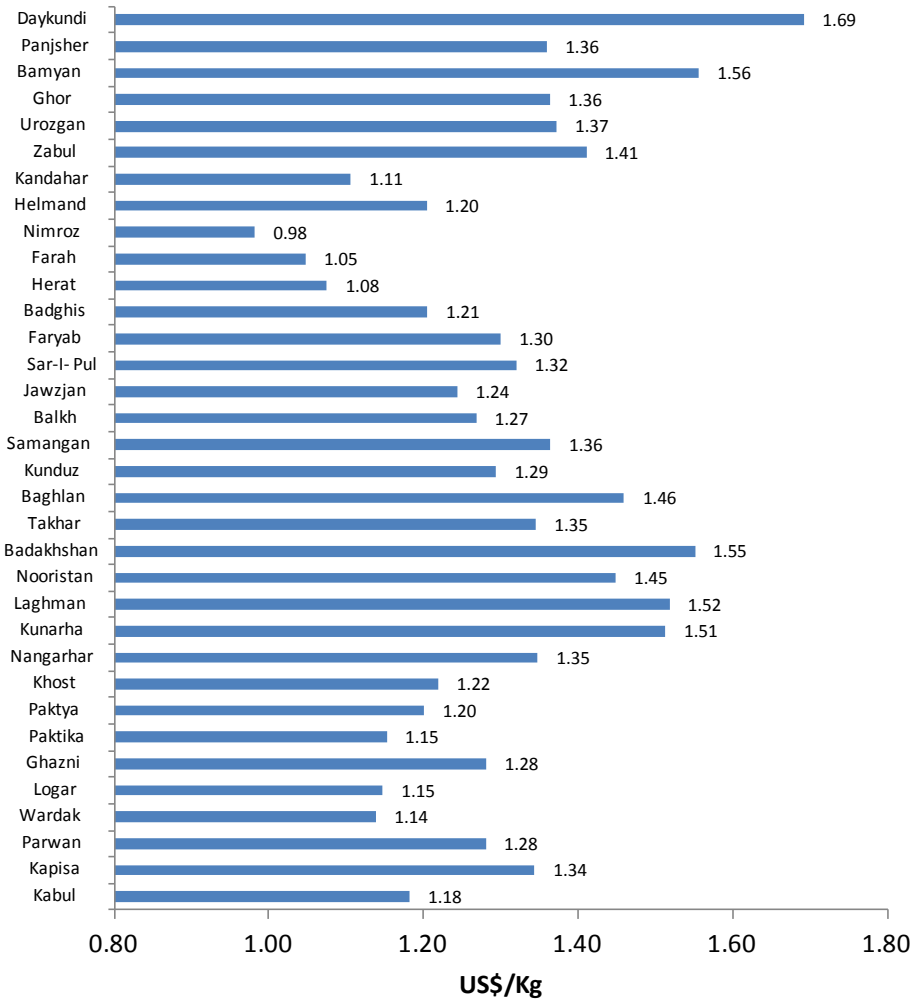


Table 45 presents the main statistics for the monthly LPG consumption in Afghanistan. As expected the consumption in the urban areas is larger than in rural areas, 9.29 vs. 1.94 Kg per month. This is expected since the rural proportion of the country is larger than the urban, so the average consumption of the country is close to the rural consumption level. Also, Figure 28 presents the LPG demand for the Provinces, and it's clear to see that only the urban regions of the capital present a demand similar to other countries (11.1 Kg/month by each family), in second and third place are Jowzjan and Kunduz. This creates an opportunity for NG because many families consume this product and the consumption by each family is relatively high, between 5 and 6 Kg per month.[41]

[41] Annex 6 presents the results for all the Provinces.

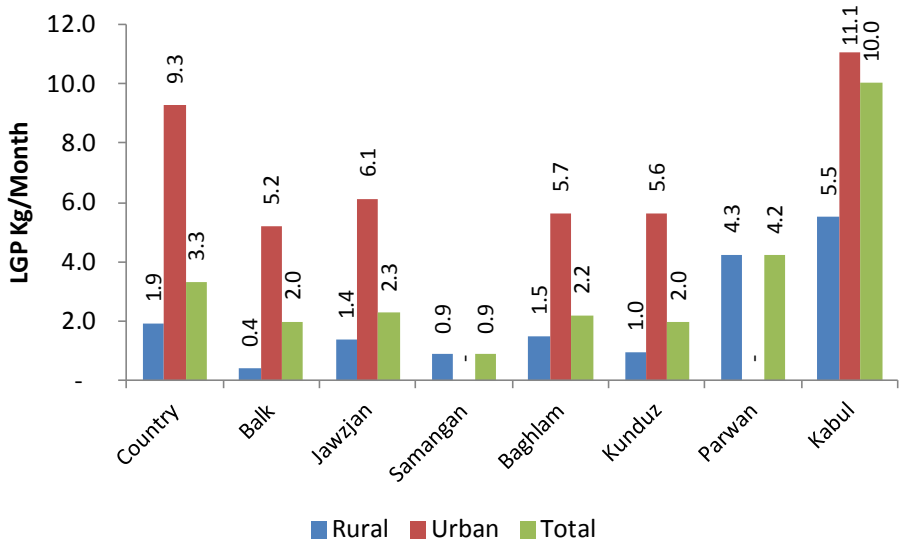
Table 45: LPG Demand in Afghanistan 2007 (Kg/Month)

Concept	Rural	Urban	Total
Total			
Mean	1.94	9.29	3.34
Standard Deviation	3.77	7.53	5.57
Max.	117.79	135.47	135.47
Min.	-	-	-

Source: NRVA Survey 2007

Elaboration: Own

Figure 28: LPG Demand 2007: Kabul and North Provinces (Kg/Month)



4.2.11 Residential Demand

Some assumptions are needed in order to project the possible future demand for NG by the residential consumer in the Provinces. Since the conversion of the energy source utilization by these families from another source of energy to NG is prohibitively expensive on a purchasing power basis in the case of heating and lighting (i.e., the purchase of NG furnaces or NG fueled electric generators), this report will only consider the substitution of NG for LPG used for cooking.[42]

The following methodology was applied: 1) the average LPG consumption by the family in the urban areas of the Provinces was converted into energy equivalence; 2) then this energy equivalence was converted into NG units; 3) the market participation of NG was assumed to start with 1,000 families in each urban region of the Provinces and the final number of targeted families would depend of the current use level of LPG for cooking reported by families. Table 46 shows the percentage targets and also the ultimate number of families that, with great probability, would use NG for cooking. The target market penetration in each Province will be completed within 10 years.

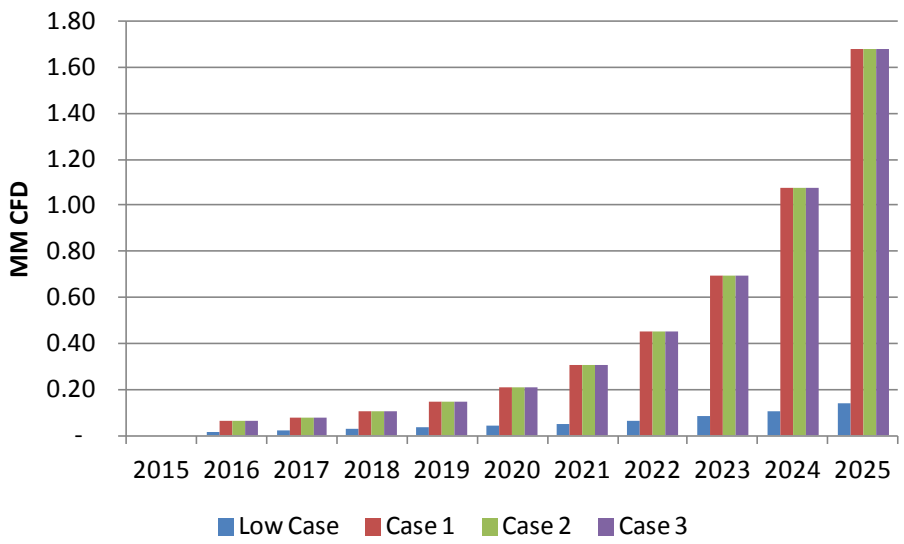
[42] The implicit assumption is that the LPG stove can be converted to NG at little or no cost.

Table 46: NG Participation in the LPG Market for Cooking - Residential

Province	Target Families NG		Number of Families NG	
	Rural	Urban	Rural	Urban
Balk	-	30%	-	18,805
Jawzjan	-	20%	-	3,065
Samangan	-	5%	-	195
Baghlan	-	30%	-	6,158
Kunduz	-	30%	-	8,060
Parwan	-	5%	-	390
Kabul	-	30%	-	137,453

Using the assumptions previously discussed, Figure 29 presents the possible future demand of NG for residential uses in the four cases under analysis.[43] The characteristics of demand in the previous results for the industrial, commercial and CNG sector remain the same. Cases 1, 2 and 3 are significantly superior to the Low Case and the main reason for this result is the high demand in Kabul.

Figure 29: NG Projected Demand for Residential Use (MMCFD)



4.3 Wellhead Gas Pricing

The objective of this section is to find the wellhead prices for each of the alternatives for NG considering industrial, commercial, power plant, CNG and residential demand, under the four case scenarios previously described. It is necessary to estimate two types of cost components: 1) the incremental distribution system cost to determine the price at the city gate; and 2) the incremental transmission pipeline cost to get the price at the wellhead. The main assumption behind the netback methodology is that the NG has to compete with the alternatives sources of energy: 1) coal; 2) LPG; and 3) gasoline for the relevant customers.

To find these two costs the methodology will involve the construction of a cash flow model for the distribution system in each urban region of the Provinces along with the transmission pipeline system. Then the NG purchase price at city gate will be set to allow the Local Distribution Company ("LDC") to generate an IRR of 15%. The same process will be used with the transport system, finding the transport

[43] A detail table of these results can be found in Annex 7.

tariff that produces allows an IRR equal to 15%. With both the distribution and transmission pipeline system prices and the final NG sales price to the consumer (shown in Table 21) it is possible to determine the price that the gas supplier, including the gas fields and any gas processing plant, will receive.

There are some assumptions needed for the construction of the cash flow model and the methodology used. The most important assumptions for the distribution system are the following:

- There's one LDC for each main city in the Provinces. This LDC will provide NG to the industries and commercial sector, CNG stations and residential consumers.
- The period to recover the initial investment is 30 years.
- The LDC buys the NG in the city gate point.
- The incremental capital expenditures (CAPEX) are a function of the number of household that will receive NG at their locations, the cost per interconnection assumed for each region are a function of the population density:[44]

  Mazar-e-Sharif: US$ 1,353
  Sheberghan: US$ 2,591
  Samangan: US$ 1,994
  Baghlan: US$ 3,280
  Kunduz: US$ 1,353
  Charikar: US$ 2,591
  Kabul: US$ 733
- The operational expenses (OPEX) are calculated as US$10/MCM.
- The applicable income tax is 20%.
- As shown in Table 21, the final competitive consumer prices are as follows:
  1) US$517/MCM for residential users based on LPG.
  2) US$182/MCM for industrial and commercial users based on coal prices.
  3) In the case of CNG, the sale price by the LDC to the owner of the CNG Station is US$150/MCM at the city gate price with the margin up to the CNG sales price covering the CAPEX and OPEX of the CNG station.
- The sale volumes for each segment were described in previous sections.[45]

The following modeling methodology will solve this equation to produce a 15% IRR:

$$\sum_{t=0}^{T} \frac{CF_t}{(1+IRR)^t} - I_0 = 0$$

Where:

CF_t = Cash flow in period "t"

T = Final period of the cash flow

I_0= Initial Investment

The CF_t is calculated with the following equation:

$$CF_t = R_t - NG_t - Opex_t - IT_t$$

[44] US$ of 2013.

[45] The detail for these volumes are set forth in Annex 8.

Where R_t represents the gross revenues at period t, NG_t is the cost of the purchase of NG, $Opex_t$ are the operation expenses at period t and IT_t is the Income Tax pay by the company. The determination of the gross revenues can be performed using the following equation:

$$R_t = P_{r,t} \cdot V_{r,t} + P_{ic,t} \cdot \left(V_{i,t} + V_{c,t}\right) + P_{cng,t} \cdot V_{cng,t}$$

Where:

$P_{r,t}$ = Is the NG price to the residential consumers at period t

$V_{r,t}$ = Is the NG volume sales to the residential consumers at period t

$P_{ic,t}$ = Is the NG price to the industrial and commercial consumers at period t

$V_{i,t}$ = Is the NG volume sales to the industrial consumers at period t

$V_{c,t}$ = Is the NG volume sales to the commercial consumers at period t

$P_{cng,t}$ = Is the NG price to the CNG station at period t

$V_{cng,t}$ = Is the NG volume sales to the CNG station at period t

The NG purchase can be expressed as:

$$NG_t = P_{ng,t} \cdot \left(V_{r,t} + V_{i,t} + V_{ct} + V_{cng,t}\right)$$

Where:

$P_{ng,t}$ = Is the purchase NG price at period t

The following equation can determine $P_{ng,t}$:

$$\sum_{t=0}^{30} \frac{P_{r,t} \cdot V_{r,t} + P_{ic,t} \cdot \left(V_{i,t} + V_{c,t}\right) + P_{cng,t} \cdot V_{cng,t} - P_{ng,t} \cdot \left(V_{r,t} + V_{i,t} + V_{ct} + V_{cng,t}\right) - Opex_t - IT_t}{(1 + 0.15)^t} - I_0 = 0$$

With these equations it is possible to construct the cash flow models for the major cities in the Provinces, Table 47 for Mazar-e-Sharif, Table 48 for Sheberghan, Table 49 for Samangan, Table 50 for Baghlan, Table 51 for Kunduz, Table 52 for Charikar and Table 53 for Kabul. As mentioned before, the cash flow model extends until 2045 to reflect the minimum economic lives of the systems but the Report will only display the cash flow results until 2025.

In general, due to the age and poor quality of the existing transmission and distribution systems, the following SGGA cost analysis assumes that all NG infrastructures, except the repaired pipeline to Mazar and the parallel pipeline to Mazar funded by TFSBO, will be replaced by new transmission and distribution systems.

Table 47: Local Distribution Company Cash Flow in Balk

Estimation of the natural gas prices in the distribution system - Balk (Mazar e Sharif)

Investment	MM US$	25.45	IRR	15%
Capex per HH	US$	1,353.23		
Residential	# Families	18,805		
Residential	Years	10		
Price NG	US$/MCM	141.8		

Concept	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Investment	000 US$	25,448										
Revenues	000 US$	-	7,037	10,900	14,944	19,177	23,608	28,246	33,102	38,189	39,409	40,699
Residential	000 US$	-	43	58	77	104	139	186	250	335	450	603
Families	#	-	1,000	1,341	1,798	2,411	3,234	4,336	5,815	7,798	10,457	14,023
Volume	000 LPG Kg	-	62.56	83.89	112.50	150.86	202.31	271.29	363.80	487.86	654.21	877.30
Volume	MM CF	-	2.94	3.94	5.29	7.09	9.51	12.75	17.10	22.93	30.75	41.23
Volume	MM CF	-	2.94	3.94	5.29	7.09	9.51	12.75	17.10	22.93	30.75	41.23
Price	US$/MCM	517	517	517	517	517	517	517	517	517	517	517
Com. & Ind.	000 US$	-	6,835	10,516	14,366	18,391	22,596	26,987	31,572	36,357	37,236	38,136
Volume	000 LPG Kg	1,910.89	1,955.60	2,001.36	2,048.19	2,096.12	2,145.17	2,195.37	2,246.74	2,299.31	2,353.12	2,408.18
Volume	MM CF	89.81	91.91	94.06	96.27	98.52	100.82	103.18	105.60	108.07	110.60	113.18
Market	%	0%	0%	5%	10%	15%	20%	25%	30%	35%	40%	45%
Volume	MM CF	-	-	4.70	9.63	14.78	20.16	25.80	31.68	37.82	44.24	50.93
Volume	000 Coal Kg	262,366	268,505	274,788	281,218	287,799	294,533	301,425	308,479	315,697	323,084	330,644
Volume	MM CF	6,478	6,630	6,785	6,944	7,106	7,273	7,443	7,617	7,795	7,978	8,164
Market	%	0%	20%	30%	40%	50%	60%	70%	80%	90%	90%	90%
Volume	MM CF	-	1,326.0	2,035.5	2,777.5	3,553.1	4,363.5	5,209.9	6,093.5	7,015.6	7,179.8	7,347.8
Price	US$/MCM	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34
CNG	000 US$	-	159.21	325.80	500.18	682.55	873.15	1,072.16	1,280.24	1,497.16	1,723.76	1,959.84
Volume	MM CF	-	37.55	76.83	117.96	160.97	205.92	252.85	301.92	353.08	406.52	462.20
Price	US$/MCM	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00
Costs		-	5,848.27	9,080.17	12,460.21	15,993.49	19,685.25	23,540.91	27,566.45	31,767.19	32,728.04	33,716.14
Natural Gas	MM CF	-	1,363.52	2,117.04	2,905.09	3,728.87	4,589.61	5,488.55	6,427.10	7,406.50	7,630.52	7,860.90
Natural Gas	000 US$	-	5,466.86	8,487.99	11,647.60	14,950.45	18,401.44	22,005.65	25,768.66	29,695.44	30,593.62	31,517.29
Opex	000 US$	-	381.40	592.18	812.61	1,043.04	1,283.81	1,535.26	1,797.79	2,071.75	2,134.41	2,198.85
Tax	000 US$		68.07	194.24	327.04	467.03	614.85	771.33	937.52	1,114.72	1,166.59	1,226.95
Revenues	000 US$		7,037	10,900	14,944	19,177	23,608	28,246	33,102	38,189	39,409	40,699
Opex	000 US$		5,848	9,080	12,460	15,993	19,685	23,541	27,566	31,767	32,728	33,716
Capex	000 US$		848	848	848	848	848	848	848	848	848	848
Cash Flow	**000 US$**	**(25,447.5)**	**1,120.5**	**1,625.2**	**2,156.4**	**2,716.4**	**3,307.6**	**3,933.6**	**4,598.3**	**5,307.2**	**5,514.6**	**5,756.0**

Table 48: Local Distribution Company Cash Flow in Jowzjan

Estimation of the natural gas prices in the distribution system - Jawzjan (Sheberghan)

Investment	MM US$	7.94	IRR	15%
Capex per HH	US$	2,590.75		
Residential	# Families	3,065		
Residential	Years	10		
Price NG	US$/MCM	127.2		

Concept	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Investment	000 US$	7,940										
Revenues	000 US$	-	1,544	2,350	3,186	4,055	4,956	5,891	6,861	7,867	8,046	8,230
Residential	000 US$	-	51	57	63	71	79	89	99	111	124	139
Families	#	-	1,000	1,119	1,251	1,399	1,565	1,751	1,958	2,190	2,450	2,740
Volume	000 LPG Kg	-	73.67	82.40	92.16	103.08	115.30	128.96	144.24	161.34	180.46	201.84
Volume	MM CF	-	3.46	3.87	4.33	4.84	5.42	6.06	6.78	7.58	8.48	9.49
Volume	MM CF	-	3.46	3.87	4.33	4.84	5.42	6.06	6.78	7.58	8.48	9.49
Price	US$/MCM	517	517	517	517	517	517	517	517	517	517	517
Com. & Ind.	000 US$	-	1,485	2,275	3,095	3,946	4,829	5,743	6,692	7,674	7,827	7,984
Volume	000 LPG Kg	415.19	423.16	431.28	439.56	448.00	456.60	465.37	474.31	483.41	492.69	502.15
Volume	MM CF	19.51	19.89	20.27	20.66	21.06	21.46	21.87	22.29	22.72	23.16	23.60
Market	%	0%	0%	5%	10%	15%	20%	25%	30%	35%	40%	45%
Volume	MM CF	-	-	1.01	2.07	3.16	4.29	5.47	6.69	7.95	9.26	10.62
Volume	000 Coal Kg	57,232	58,331	59,451	60,593	61,756	62,942	64,150	65,382	66,637	67,917	69,221
Volume	MM CF	1,413	1,440	1,468	1,496	1,525	1,554	1,584	1,614	1,645	1,677	1,709
Market	%	0%	20%	30%	40%	50%	60%	70%	80%	90%	90%	90%
Volume	MM CF	-	288.1	440.4	598.5	762.4	932.5	1,108.8	1,291.5	1,480.9	1,509.3	1,538.3
Price	US$/MCM	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34
CNG	000 US$	-	8.85	17.90	27.59	37.49	48.02	58.97	70.34	82.34	94.77	107.83
Volume	MM CF	-	2.09	4.22	6.51	8.84	11.32	13.91	16.59	19.42	22.35	25.43
Price	US$/MCM	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00
Costs		-	1,124.76	1,727.46	2,353.16	3,002.10	3,675.34	4,373.35	5,096.83	5,846.67	5,973.33	6,102.86
Natural Gas	MM CF	-	290.15	445.62	607.03	774.43	948.10	1,128.16	1,314.79	1,508.23	1,540.90	1,574.31
Natural Gas	000 US$	-	1,043.60	1,602.81	2,183.36	2,785.48	3,410.14	4,057.78	4,729.05	5,424.79	5,542.31	5,662.50
Opex	000 US$	-	81.16	124.65	169.80	216.62	265.20	315.57	367.77	421.88	431.02	440.37
Tax	000 US$		30.97	71.52	113.70	157.56	203.17	250.60	299.91	351.18	361.62	372.54
Revenues	000 US$		1,544	2,350	3,186	4,055	4,956	5,891	6,861	7,867	8,046	8,230
Opex	000 US$		1,125	1,727	2,353	3,002	3,675	4,373	5,097	5,847	5,973	6,103
Capex	000 US$		265	265	265	265	265	265	265	265	265	265
Cash Flow	**000 US$**	**(7,939.6)**	**388.5**	**550.7**	**719.4**	**894.9**	**1,077.3**	**1,267.0**	**1,464.3**	**1,669.4**	**1,711.1**	**1,754.8**

Table 49: Local Distribution Company Cash Flow in Samangan

Estimation of the natural gas prices in the distribution system - Samangan

Investment	MM US$	0.39	IRR	15%
Capex per HH	US$	1,994.04		
Residential	# Families	195		
Residential	Years	10		
Price NG	US$/MCM	161.4		

Concept	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Investment	000 US$	388										
Revenues	000 US$	-	379	566	752	940	1,127	1,314	1,501	1,689	1,692	1,694
Residential	000 US$	-	7	6	5	4	4	3	3	2	2	2
Families	#	-	1,000	849	721	612	520	441	375	318	270	229
Volume	000 LPG Kg	-	10.58	8.98	7.63	6.48	5.50	4.67	3.96	3.37	2.86	2.43
Volume	MM CF	-	0.50	0.42	0.36	0.30	0.26	0.22	0.19	0.16	0.13	0.11
Volume	MM CF	-	0.50	0.42	0.36	0.30	0.26	0.22	0.19	0.16	0.13	0.11
Price	US$/MCM	517	517	517	517	517	517	517	517	517	517	517
Com. & Ind.	000 US$	-	370	556	742	929	1,115	1,301	1,487	1,674	1,675	1,676
Volume	000 LPG Kg	105.58	105.58	105.58	105.58	105.58	105.58	105.58	105.58	105.58	105.58	105.58
Volume	MM CF	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96	4.96
Market	%	0%	0%	5%	10%	15%	20%	25%	30%	35%	40%	45%
Volume	MM CF	-	-	0.25	0.50	0.74	0.99	1.24	1.49	1.74	1.98	2.23
Volume	000 Coal Kg	14,532	14,532	14,532	14,532	14,532	14,532	14,532	14,532	14,532	14,532	14,532
Volume	MM CF	359	359	359	359	359	359	359	359	359	359	359
Market	%	0%	20%	30%	40%	50%	60%	70%	80%	90%	90%	90%
Volume	MM CF	-	71.8	107.6	143.5	179.4	215.3	251.2	287.1	322.9	322.9	322.9
Price	US$/MCM	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34
CNG	000 US$	-	1.68	3.37	4.84	6.53	8.21	9.90	11.37	13.06	14.74	16.43
Volume	MM CF	-	0.40	0.79	1.14	1.54	1.94	2.33	2.68	3.08	3.48	3.87
Price	US$/MCM	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00
Costs		-	349.51	526.43	703.10	880.02	1,056.94	1,233.86	1,410.54	1,587.46	1,590.58	1,593.71
Natural Gas	MM CF	-	72.16	108.69	145.17	181.70	218.22	254.75	291.23	327.76	328.40	329.05
Natural Gas	000 US$	-	329.32	496.02	662.50	829.20	995.90	1,162.60	1,329.07	1,495.77	1,498.72	1,501.67
Opex	000 US$	-	20.19	30.40	40.61	50.82	61.04	71.26	81.46	91.68	91.86	92.04
Tax	000 US$		3.28	5.26	7.28	9.32	11.39	13.47	15.58	17.70	17.60	17.51
Revenues	000 US$		379	566	752	940	1,127	1,314	1,501	1,689	1,692	1,694
Opex	000 US$		350	526	703	880	1,057	1,234	1,411	1,587	1,591	1,594
Capex	000 US$		13	13	13	13	13	13	13	13	13	13
Cash Flow	**000 US$**	**(388.5)**	**26.1**	**34.0**	**42.1**	**50.2**	**58.5**	**66.8**	**75.3**	**83.8**	**83.3**	**83.0**

Table 50: Local Distribution Company Cash Flow in Baghlan

Estimation of the natural gas prices in the distribution system - Baghlan

Investment	MM US$	20.20	IRR	15%
Capex per HH	US$	3,279.81		
Residential	# Families	6,158		
Residential	Years	10		
Price NG	US$/MCM	85.2		

Concept	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Investment	000 US$	20,199										
Revenues	000 US$	-	2,065	3,163	4,301	5,483	6,708	7,979	9,297	10,665	10,937	11,220
Residential	000 US$	-	47	56	67	80	96	116	139	166	200	239
Families	#	-	1,000	1,199	1,438	1,725	2,069	2,482	2,976	3,570	4,281	5,135
Volume	000 LPG Kg	-	67.82	81.34	97.55	117.00	140.32	168.30	201.85	242.09	290.35	348.23
Volume	MM CF	-	3.19	3.82	4.58	5.50	6.60	7.91	9.49	11.38	13.65	16.37
Volume	MM CF	-	3.19	3.82	4.58	5.50	6.60	7.91	9.49	11.38	13.65	16.37
Price	US$/MCM	517	517	517	517	517	517	517	517	517	517	517
Com. & Ind.	000 US$	-	1,985	3,039	4,130	5,261	6,432	7,643	8,897	10,195	10,389	10,587
Volume	000 LPG Kg	556.31	566.49	576.86	587.41	598.16	609.11	620.26	631.61	643.16	654.93	666.92
Volume	MM CF	26.15	26.62	27.11	27.61	28.11	28.63	29.15	29.69	30.23	30.78	31.35
Market	%	0%	0%	5%	10%	15%	20%	25%	30%	35%	40%	45%
Volume	MM CF	-	-	1.36	2.76	4.22	5.73	7.29	8.91	10.58	12.31	14.11
Volume	000 Coal Kg	76,569	77,971	79,398	80,850	82,330	83,837	85,371	86,933	88,524	90,144	91,794
Volume	MM CF	1,891	1,925	1,960	1,996	2,033	2,070	2,108	2,147	2,186	2,226	2,267
Market	%	0%	20%	30%	40%	50%	60%	70%	80%	90%	90%	90%
Volume	MM CF	-	385.0	588.1	798.5	1,016.4	1,242.0	1,475.6	1,717.2	1,967.2	2,003.2	2,039.9
Price	US$/MCM	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34
CNG	000 US$	-	33.49	68.23	104.04	141.31	179.85	219.87	261.14	303.90	348.12	393.82
Volume	MM CF	-	7.90	16.09	24.54	33.33	42.42	51.85	61.59	71.67	82.10	92.88
Price	US$/MCM	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00
Costs		-	1,056.65	1,628.47	2,220.72	2,834.23	3,469.40	4,126.95	4,807.31	5,511.21	5,640.72	5,773.10
Natural Gas	MM CF	-	392.94	605.59	825.83	1,053.98	1,290.19	1,534.71	1,787.72	2,049.48	2,097.64	2,146.87
Natural Gas	000 US$	-	946.74	1,459.07	1,989.72	2,539.41	3,108.51	3,697.66	4,307.24	4,937.92	5,053.97	5,172.58
Opex	000 US$	-	109.91	169.39	231.00	294.82	360.89	429.29	500.06	573.28	586.75	600.52
Tax	000 US$		66.97	172.18	281.47	395.03	513.04	635.73	763.31	896.07	924.54	954.80
Revenues	000 US$		2,065	3,163	4,301	5,483	6,708	7,979	9,297	10,665	10,937	11,220
Opex	000 US$		1,057	1,628	2,221	2,834	3,469	4,127	4,807	5,511	5,641	5,773
Capex	000 US$		673	673	673	673	673	673	673	673	673	673
Cash Flow	**000 US$**	**(20,198.5)**	**941.2**	**1,362.0**	**1,799.1**	**2,253.4**	**2,725.4**	**3,216.2**	**3,726.5**	**4,257.6**	**4,371.5**	**4,492.5**

Table 51: Local Distribution Company Cash Flow in Kunduz

Estimation of the natural gas prices in the distribution system - Kunduz

Investment	MM US$	10.91	IRR	15%
Capex per HH	US$	1,353.23		
Residential	# Families	8,060		
Residential	Years	10		
Price NG	US$/MCM	138.5		

Concept	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Investment	000 US$	10,907										
Revenues	000 US$	-	2,702	4,163	5,688	7,281	8,944	10,682	12,495	14,390	14,817	15,265
Residential	000 US$	-	46	57	70	87	107	132	162	200	247	304
Families	#	-	1,000	1,232	1,518	1,870	2,304	2,839	3,498	4,310	5,310	6,542
Volume	000 LPG Kg	-	67.57	83.26	102.58	126.38	155.71	191.84	236.36	291.22	358.80	442.06
Volume	MM CF	-	3.18	3.91	4.82	5.94	7.32	9.02	11.11	13.69	16.86	20.78
Volume	MM CF	-	3.18	3.91	4.82	5.94	7.32	9.02	11.11	13.69	16.86	20.78
Price	US$/MCM	517	517	517	517	517	517	517	517	517	517	517
Com. & Ind.	000 US$	-	2,607	4,006	5,465	6,986	8,572	10,224	11,944	13,735	14,048	14,368
Volume	000 LPG Kg	728.10	744.11	760.48	777.21	794.31	811.79	829.65	847.90	866.55	885.62	905.10
Volume	MM CF	34.22	34.97	35.74	36.53	37.33	38.15	38.99	39.85	40.73	41.62	42.54
Market	%	0%	0%	5%	10%	15%	20%	25%	30%	35%	40%	45%
Volume	MM CF	-	-	1.79	3.65	5.60	7.63	9.75	11.96	14.25	16.65	19.14
Volume	000 Coal Kg	100,214	102,419	104,672	106,975	109,328	111,733	114,191	116,704	119,271	121,895	124,577
Volume	MM CF	2,474	2,529	2,585	2,641	2,700	2,759	2,820	2,882	2,945	3,010	3,076
Market	%	0%	20%	30%	40%	50%	60%	70%	80%	90%	90%	90%
Volume	MM CF	-	505.8	775.4	1,056.6	1,349.8	1,655.3	1,973.7	2,305.3	2,650.5	2,708.8	2,768.4
Price	US$/MCM	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34
CNG	000 US$	-	48.65	99.61	152.69	208.07	265.78	326.01	388.56	454.05	521.87	592.63
Volume	MM CF	-	11.47	23.49	36.01	49.07	62.68	76.88	91.63	107.08	123.07	139.76
Price	US$/MCM	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00
Costs		-	2,170.37	3,359.45	4,599.69	5,892.90	7,240.74	8,645.12	10,107.58	11,630.56	11,952.39	12,282.93
Natural Gas	MM CF	-	517.25	800.64	1,096.22	1,404.42	1,725.64	2,060.34	2,408.88	2,771.85	2,848.55	2,927.32
Natural Gas	000 US$	-	2,025.68	3,135.49	4,293.05	5,500.05	6,758.04	8,068.80	9,433.77	10,855.22	11,155.59	11,464.10
Opex	000 US$	-	144.69	223.95	306.63	392.84	482.70	576.32	673.81	775.34	796.80	818.83
Tax	000 US$		33.63	87.92	144.95	204.91	268.03	334.57	404.80	479.10	500.17	523.66
Revenues	000 US$		2,702	4,163	5,688	7,281	8,944	10,682	12,495	14,390	14,817	15,265
Opex	000 US$		2,170	3,359	4,600	5,893	7,241	8,645	10,108	11,631	11,952	12,283
Capex	000 US$		364	364	364	364	364	364	364	364	364	364
Cash Flow	**000 US$**	**(10,907.2)**	**498.1**	**715.2**	**943.4**	**1,183.2**	**1,435.7**	**1,701.8**	**1,982.8**	**2,280.0**	**2,364.2**	**2,458.2**

Table 52: Local Distribution Company Cash Flow in Parwan

Estimation of the natural gas prices in the distribution system - Parwan (Charikar)

Investment	MM US$	1.01	IRR	15%
Capex per HH	US$	2,590.75		
Residential	# Families	390		
Residential	Years	10		
Price NG	US$/MCM	159.3		

Concept	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Investment	000 US$	1,009										
Revenues	000 US$	-	779	1,152	1,526	1,900	2,274	2,648	3,022	3,397	3,402	3,407
Residential	000 US$	-	35	32	29	26	24	22	20	18	16	15
Families	#	-	1,000	910	828	754	686	624	568	517	470	428
Volume	000 LPG Kg	-	51.02	46.43	42.25	38.45	34.99	31.84	28.98	26.37	24.00	21.84
Volume	MM CF	-	2.40	2.18	1.99	1.81	1.64	1.50	1.36	1.24	1.13	1.03
Volume	MM CF	-	2.40	2.18	1.99	1.81	1.64	1.50	1.36	1.24	1.13	1.03
Price	US$/MCM	517	517	517	517	517	517	517	517	517	517	517
Com. & Ind.	000 US$	-	740	1,112	1,485	1,857	2,230	2,602	2,975	3,348	3,350	3,353
Volume	000 LPG Kg	211.19	211.19	211.19	211.19	211.19	211.19	211.19	211.19	211.19	211.19	211.19
Volume	MM CF	9.93	9.93	9.93	9.93	9.93	9.93	9.93	9.93	9.93	9.93	9.93
Market	%	0%	0%	5%	10%	15%	20%	25%	30%	35%	40%	45%
Volume	MM CF	-	-	0.50	0.99	1.49	1.99	2.48	2.98	3.47	3.97	4.47
Volume	000 Coal Kg	29,068	29,068	29,068	29,068	29,068	29,068	29,068	29,068	29,068	29,068	29,068
Volume	MM CF	718	718	718	718	718	718	718	718	718	718	718
Market	%	0%	20%	30%	40%	50%	60%	70%	80%	90%	90%	90%
Volume	MM CF	-	143.5	215.3	287.1	358.9	430.6	502.4	574.2	646.0	646.0	646.0
Price	US$/MCM	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34
CNG	000 US$	-	4.00	7.79	11.79	15.80	19.80	23.59	27.59	31.59	35.38	39.38
Volume	MM CF	-	0.94	1.84	2.78	3.72	4.67	5.56	6.51	7.45	8.34	9.29
Price	US$/MCM	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00
Costs		-	691.21	1,041.21	1,391.44	1,741.68	2,091.91	2,441.91	2,792.14	3,142.38	3,149.03	3,155.92
Natural Gas	MM CF	-	144.49	217.66	290.87	364.08	437.30	510.46	583.67	656.89	658.28	659.72
Natural Gas	000 US$	-	650.79	980.32	1,310.08	1,639.83	1,969.59	2,299.12	2,628.88	2,958.63	2,964.90	2,971.38
Opex	000 US$	-	40.42	60.88	81.36	101.84	122.32	142.79	163.27	183.74	184.13	184.54
Tax	000 US$		10.82	15.45	20.14	24.87	29.65	34.48	39.34	44.24	43.85	43.49
Revenues	000 US$		779	1,152	1,526	1,900	2,274	2,648	3,022	3,397	3,402	3,407
Opex	000 US$		691	1,041	1,391	1,742	2,092	2,442	2,792	3,142	3,149	3,156
Capex	000 US$		34	34	34	34	34	34	34	34	34	34
Cash Flow	**000 US$**	**(1,009.5)**	**76.9**	**95.5**	**114.2**	**133.1**	**152.2**	**171.6**	**191.0**	**210.6**	**209.1**	**207.6**

Table 53: Local Distribution Company Cash Flow in Kabul

Estimation of the natural gas prices in the distribution system - Kabul

Investment	MM US$	100.78	IRR	15%
Capex per HH	US$	733.17		
Residential	# Families	137,453		
Residential	Years	10		
Price NG	US$/MCM	156.7		

Concept	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Investment	000 US$	100,776	46,001,183	8,952	253,066	182						
Revenues	000 US$	-	46,001	71,826	99,213	128,253	159,056	191,760	226,547	263,663	274,991	287,816
Residential	000 US$	-	91	149	245	400	655	1,071	1,753	2,868	4,692	7,676
Families	#	-	1,000	1,636	2,677	4,380	7,166	11,724	19,182	31,384	51,348	84,012
Volume	000 LPG Kg	-	132.95	217.52	355.90	582.29	952.69	1,558.72	2,550.26	4,172.54	6,826.78	11,169.44
Volume	MM CF	-	6.25	10.22	16.73	27.37	44.78	73.26	119.86	196.11	320.86	524.96
Volume	MM CF	-	6.25	10.22	16.73	27.37	44.78	73.26	119.86	196.11	320.86	524.96
Price	US$/MCM	517	517	517	517	517	517	517	517	517	517	517
Com. & Ind.	000 US$	-	44,824	69,440	95,511	123,103	152,285	183,127	215,703	250,090	257,890	265,933
Volume	000 LPG Kg	12,416.62	12,794.09	13,183.03	13,583.79	13,996.74	14,422.24	14,860.68	15,312.44	15,777.94	16,257.59	16,751.82
Volume	MM CF	583.58	601.32	619.60	638.44	657.85	677.85	698.45	719.68	741.56	764.11	787.34
Market	%	0%	0%	5%	10%	15%	20%	25%	30%	35%	40%	45%
Volume	MM CF	-	-	30.98	63.84	98.68	135.57	174.61	215.91	259.55	305.64	354.30
Volume	000 Coal Kg	1,709,004	1,760,958	1,814,491	1,869,651	1,926,489	1,985,054	2,045,400	2,107,580	2,171,650	2,237,668	2,305,693
Volume	MM CF	42,198	43,481	44,803	46,165	47,568	49,014	50,504	52,040	53,622	55,252	56,932
Market	%	0%	20%	30%	40%	50%	60%	70%	80%	90%	90%	90%
Volume	MM CF	-	8,696.2	13,440.9	18,466.0	23,784.2	29,408.7	35,353.1	41,631.9	48,259.7	49,726.8	51,238.4
Price	US$/MCM	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34	182.34
CNG	000 US$	-	1,085.43	2,236.57	3,456.79	4,749.03	6,116.67	7,562.65	9,091.18	10,705.22	12,409.18	14,206.44
Volume	MM CF	-	255.98	527.46	815.23	1,119.98	1,442.51	1,783.52	2,144.00	2,524.65	2,926.50	3,350.35
Price	US$/MCM	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00	150.00
Costs		-	42,163.19	65,934.16	91,111.53	117,758.65	145,941.74	175,729.06	207,192.90	240,406.85	249,426.33	258,771.56
Natural Gas	MM CF	-	8,952.21	13,999.32	19,345.05	25,002.85	30,986.76	37,311.28	43,991.77	51,043.85	52,958.89	54,943.10
Natural Gas	000 US$	-	39,659.08	62,018.26	85,700.33	110,764.85	137,274.11	165,292.34	194,887.51	226,128.85	234,612.66	243,402.86
Opex	000 US$	-	2,504.11	3,915.89	5,411.20	6,993.80	8,667.62	10,436.72	12,305.39	14,278.00	14,813.68	15,368.70
Tax	000 US$		95.76	506.59	948.39	1,426.94	1,951.04	2,534.44	3,198.92	3,979.46	4,441.13	5,137.01
Revenues	000 US$		46,001	71,826	99,213	128,253	159,056	191,760	226,547	263,663	274,991	287,816
Opex	000 US$		42,163	65,934	91,112	117,759	145,942	175,729	207,193	240,407	249,426	258,772
Capex	000 US$		3,359	3,359	3,359	3,359	3,359	3,359	3,359	3,359	3,359	3,359
Cash Flow	**000 US$**	**(100,776.3)**	**3,742.2**	**5,385.6**	**7,152.8**	**9,067.0**	**11,163.4**	**13,497.0**	**16,154.9**	**19,277.1**	**21,123.7**	**23,907.3**

Using the described methodology, the prices expressed in US$/MCM at each city gate for each region are:

Mazar-e-Sharif:	141.8
Sheberghan:	127.2
Samangan:	161.4
Baghlan:	85.2
Kunduz:	138.5
Charikar:	159.3
Kabul:	156.7

To establish the pipeline transport tariff, a similar methodology was used, constructing a cash flow model for the transport activity and then setting the tariff that delivers a 15% IRR. The following are some important assumptions:

- The investment cost is US$ 53,911 per diameter inch per mile, the distance is 400 miles, where 60 miles are for the Baghlan - Kunduz pipeline and the rest from Sheberghan to Kabul.
- The cost of compressor stations is US$130 MM.
- The pipeline from Sheberghan to Kabul is 900 mm diameter and to Kunduz 600 mm diameter.
- The increasing demand over time requires that the capital investment is made both at the beginning of the project and during the projects as more throughput capacity is required.

The pipeline tariffs, expressed in US$/MCM, from these assumptions and the same methodology applied in the distribution case are:

Low Case:	41.1
Case 1:	48.4
Case 2:	42.5
Case 3:	61.1

It's important to note that in the Low Case scenario the transport tariff could be very low, just enough to cover OPEX because the TFBSO would not expect a return on its donor investment. However, it appears more appropriate to adopt a uniform or universal transportation tariff to support an expansion of the transmission system to supply NG to multiple cities for commercial viability and sustainability, including the largest city, Kabul, rather than favor the two cities that fortuitously were closer to the gas reserves with very low transport tariffs. Since Sheberghan and Mazar-e-Sharif have benefited from the existing reserves and pipeline at low costs while the rest of the country did not have NG, it seems reasonable that Sheberghan and Mazar-e-Sharif now bear some of the pricing burden of sharing NG with other parts of the country.

Also, in order to avoid rate shock from the additional costs to fund the future pipeline to Kabul, the Sheberghan and Mazar-e-Sharif consumers should begin paying the indicated transport tariff immediately. If the Kabul pipeline does not proceed, then the transportation tariffs can be reduced or refunded.

In the Case 3 scenario, the transport tariff is highest because there are no volumes of NG for power generation in Kabul to offset the costs for the other consumers.

The Table 54 and Figure 30 shows the principal results of the main assumptions and scenarios described previously. The competitive price (CP), in the table, refers to the final consumer price found in Table 21, the distribution margin (DM) refers to the analysis made in Table 47, Table 48, Table 49, Table 50, Table 51, Table 52 and Table 53; and the Price at the City Gate (PCG) is the result of the following formula:[46]

$$PCG = CP - DM$$

The estimation of the Wellhead Price (WP) is done by deducting the Transport Margin (TM) from the Price at the City Gate, as seen in the following equation:

$$WP = PCG - TM$$

In that sense, Table 54 presents these prices in each of the scenarios considered in the Report. In order to understand better the results, some observations should be made:

1) Since the fertilizer plant does benefit the entire country, it would be exempted from the transportation tariffs – no change from present status;
2) Similarly the new Sheberghan power plants (200 MW in Case 1 and 600 MW in Case 3) and in the Low Case would not pay the transport cost since the NG facilities supplying the power plants would not use the pipeline system and power may be widely used by the public, which will also pay the power transmission tariff;
3) In Cases 1, 2 and 3, the volumes for the distribution system (in all the Provinces considered in the Report) will pay the distribution margin and the transport cost;

[46] PCG = Price in City Gate, CP = Competitive Price and Dm = Distribution Margin.

4) The assumed power plant in Kabul (200 MW in case 1 and 400 MW in case 2) will pay the transport tariff since there is very substantial capital investment for gas transportation but the power is consumed in Kabul and those consumers do not pay much, if any, power transmission costs;
5) The competitive prices presented for the distribution sector (including industrial, CNG and residential demand) are the weighted[47] prices for each LDC; and
6) The Wellhead Prices presented are the weighted[48] average of the demand by the all sectors.

Table 54: Projected Transport Tariffs and Wellhead Prices

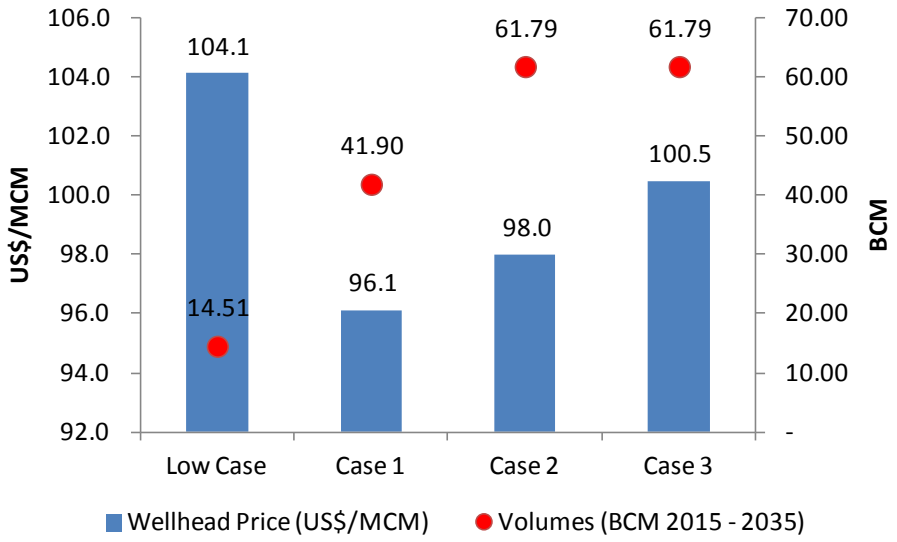
Scenarios	Project	Competitive Price (US$/MCM)	Distribution: Opex+Capex +Tax+Profit (US$/MCM)	Price City Gate (US$/MCM)	Transport: Opex+Capex +Tax+Profit (US$/MCM)	Wellhead Price (US$/MCM)
Low Case	Distribution North	181.8	46.9	135.0	41.1	93.9
	PP 200 MW Sheberghan	120.0	-	-	-	120.0
	Fertilizer Plant	34.8	-	-	-	34.8
Case 1	PP 200 MW Sheberghan	120.0	-	-	-	120.0
	Distribution North - Kabul	182.8	34.7	148.1	48.4	99.7
	PP 200 MW Kabul	120.0	-	-	48.4	71.6
	Fertilizer Plant	34.8	-	-	-	34.8
Case 2	PP 200 MW Sheberghan	120.0	-	-	-	120.0
	Distribution North - Kabul	182.8	34.7	148.1	42.5	105.6
	PP 400 MW Kabul	120.0	-	-	42.5	77.5
	Fertilizer Plant	34.8	-	-	-	34.8
Case 3	PP 600 MW Sheberghan	120.0	-	-	-	120.0
	Distribution North - Kabul	182.8	34.7	148.1	61.1	87.0
	Fertilizer Plant	34.8	-	-	-	34.8

The results found in Table 54 are summarized in Figure 30. There is the Wellhead price in each scenario and the total volumes (for period 2015 - 2035) expressed in BCM, as well. Some comments can be made with these main results:

1) The Low Case offers the highest wellhead price but on substantially lower volumes;
2) Case 1 presents lower prices and volumes (relatively to Cases 2 and 3) because it only considers a 200 MW additional plant in Kabul, so the wellhead price is lower because the transport cost is higher;
3) Cases 2 and 3 present the highest and equal volumes (there's a 600 MW generation in both alternatives) but, in Case 3 the wellhead price is higher because the NG volumes used in Sheberghan to generate the additional 600 MW don't pay the transport cost.[49] There are CAPEX and OPEX for transmitting the power from Sheberghan along with some line losses, but it is assumed that those costs are already borne by a planned 500kV transmission line to Kabul.

[47] By volume.
[48] By volume.
[49] In Case 3 the wellhead price of the distribution system is lower (because a high transport cost) but this is compensated with the higher price for the power plant generation.

Figure 30: Price and Volume Analysis



Constraints within the Current Market

After analyzing the NG market including current and projected demand, it is possible to identify some restrictions in this market that should be addressed. Accordingly, this section will explain the major findings in the industrial, commercial, CNG, residential and power generation sectors.

4.4 Industrial and Commercial Sectors

In the industrial sector the main competitor for NG use is coal because it is used extensively and the price of this source in energy terms is low. One way for the public policy to better encourage the consumption of NG would be to support greater exports of coal and perhaps to increase the domestic price of coal. With NG pricing at a discount to the market price of coal, the margin for the components of the NG value chain (production, pipeline and distribution) is tight. Exporting those domestic coal sales should be sustainable since the export prices are better than domestic prices and the means of export currently exist since more than half of the production is already exported. Also, less use of coal in Afghanistan would improve the air pollution situation. Increasing the domestic coal price is also an option to raise the NG price, however, there will likely be substantial resistance by the current coal purchasers unless NG is readily available and priced at about the same cost as they were paying for coal previously.

Regarding the commercial sector, NG can easily replace the use of LPG in bakeries, restaurants and all the commercial activities related with cooking. The main challenge will be to complete the NG distribution network in each of the cities. Once the commercial sector has access to the NG system then switching from LPG to NG is easy since their existing equipment, ovens primarily, would still work with NG, no other major investment would be required, and the price should be lower than LPG.

4.5 CNG

For CNG, there are significant constraints in attracting a major share of vehicle fuel market. The main issues are the lack of refueling stations, travel range of the CNG vehicles, and the cabin space required in light-duty CNG vehicles. The small size of CNG vehicle population constitutes another issue because building the NGV refueling infrastructure requires a sufficient number of vehicle owners demanding

CNG fuel to support the investment in the refueling stations. Availability of refueling stations can be progressively resolved. The cost of the CNG conversion kits should not be a problem as long as AGE continues with its 63% subsidy.

The assumption used in this report is that the owner of the CNG station would buy NG at the average city gate price of US$150/MCM and sell the CNG at a competitive price (see Table 21). The difference between these two prices must cover the Opex and Capex of the CNG station. Currently, the Opex and Capex are higher in Afghanistan than in other countries since the Afghan market is still small. In order to expand the use of CNG it will be necessary to have lower costs for the CNG stations than the $1.5 million cost of the first station.

4.6 Residential Sector

One of the main features of the Afghan population is the significant rural numbers, especially in the Northern provinces. The energy per household consumption and, of course, expense for those rural consumers is low. For example, the average LPG consumption per month in Afghanistan is only about 3 Kg. Based on international consumption patterns, that number is low since globally a reasonable range would be between 5 and 10 Kg per month.

In the short term this sector will not lead the NG production growth, since even if the families had access to the NG distribution system they will not immediately use NG since (as seen in other developing countries) its consumption requires an additional investment to take the NG from the distribution system to the house and also to convert the kitchen appliances, for example, from firewood to NG use. One way to facilitate the residential consumption of NG would be some financial incentives, such as rebates or financing plans for families for the additional investment needed to use NG.

4.7 Power Generation

In the power generation sector the main obstacle to increasing the NG demand is the lack of a project development road map and track record of successful projects. Additionally, there must be the appropriate electrical transmission system in place to handle the additional domestic power production. The power plant related to the SGDP should establish the business model for successive power plants. The known gas reserves at Bashikurd/Juma field are between 28 BCM and 40 BCM (billion cubic meters), at Probability of 50% and 10%, respectively. Based on a 200 MW power plant consuming about 10 BCM in a 25 year life time, there is sufficient gas reserves at Bashikurd/Juma field for an aggregate of 600 MW to 800 MW, sufficient for potential electric energy from domestic natural gas and associated energy independence. It appears that the power system planning by the ADB should eventually create the supporting electrical infrastructure needed for future power plants.

4.8 E&P Contract and Administration

According to the Hydrocarbons law 2008-2009 (1387), all Hydrocarbons located in the territory of Afghanistan are the exclusive property of the State. The MoMP formulates and implements policies relating to Hydrocarbons and their development. It also monitors all hydrocarbon operations, organizes proposals for participation of persons in bidding rounds, and executes production contracts on behalf of Afghanistan.

At the request of a Contractor, the State may put its owned property and/or privately owned land at disposal of the Contractor with the consent of the owner for the duration of the Contract. There are

some closed and restricted areas like archeological or cultural area, land forming parts of an airport, or land owned by the Ministry of Defense, etc., which are not available to support hydrocarbon development.

There are currently four types of Contracts under Afghan law to support hydrocarbon development:

- Exploration and Production Sharing Contracts: The Contractor has the exclusive right to explore for and produce Hydrocarbons, usually under a Production Sharing Agreement (PSA).
- Service and Production Sharing Contracts: Contractor will be granted the exclusive right of operation to upgrade and rehabilitate Hydrocarbon production facilities.
- Contracts for Geological/Geophysical/Geochemical Services: The contractor has the right to conduct geological/ geophysical/geochemical services in an identified area.
- Contracts for Pipeline Operations: This contract grants the right to construct pipelines and associated facilities (pumping stations, storage tanks or valves) and carry out the storage and transportation operation of Hydrocarbons.

As of the date of this Report, the MoMP staff is most familiar with PSAs for oil producing projects where oil has international price benchmarks and can be more readily transported. One challenge will be establish the appropriate pricing arrangement for NG in Afghanistan since there are no applicable price benchmarks and NG cannot be readily transported. Further, the split of the benefits between the Government and the Contractor must be sufficiently attractive to both sides. Thereafter, it will be necessary to train the MoMP staff for the administration of the contracts.

Further, it could be helpful to explore new alternatives for future contracts. For example, due to the high level of donor funding for some established fields, e.g., Yatimtaq and Gerquduq, those could be administered through risk service contracts, where the contractor undertakes certain risks and management responsibilities for a specified compensation while the Government receives most of the gross revenues, could be an attractive option.

5 Gas Exports

According to Table 55 the major NG import markets in the region are China, India, Iran and Tajikistan, while the main suppliers are Turkmenistan and LNG projects. Tajikistan does not appear to be a very attractive export market for Afghanistan because the volume of their NG imports is low and it could be difficult to displace their current supplies from Uzbekistan. Regarding China and India, these are the major markets in the region. Even after the implementation of the Iran – Pakistan pipeline, there may be enough demand to count Pakistan as an export market. Their very large and growing populations, generally vibrant economies, and comparatively limited domestic energy resource bases (excluding shale gas development in China) make them attractive export targets.

Table 55: NG Imports in the Region (MM CFD)

Country	China	India	Iran	Tajikistan	Turkmenistan	Uzbekistan
Azerbaijan	-	-	37.8	-	-	-
LNG	1,610.7	1,657.3	-	-	-	-
Turkmenistan	1,381.1	-	988.6	-	-	-
Uzbekistan	-	-	-	15.3	-	-
Total	**2,991.8**	**1,657.3**	**1,026.4**	**15.3**	**-**	**-**

Source: BP

The cost for either a pipeline to Pakistan and India or China or a pipeline and an LNG facility to China or elsewhere would be relatively high. The threshold questions for both the export pipeline and LNG options are:

1) Are the current reserves (P1) for export adequate to create the likelihood of supplying these markets for at least 20 years to amortize the multi-Billion dollar investment costs, after providing sufficient reserves (P1) to supply the Afghan market for a reasonable time period?
2) Will the delivered price be competitive with alternative energy supply options to ensure that the sales contract price will be honored?
3) Can acceptable and reliable political arrangements be established with Pakistan for the export pipeline or LNG options to support such massive capital investments?

The answer to the first question is that at this time, the current level of P1 is not large enough to consider the export markets. Once there is verification of adequate P1, the answer to the second question, may to be positive.

There appears to be up to a 77 MMCMD supply deficit for NG in Pakistan even if the Iran-Pakistan pipeline is completed. Based on its current domestic production and LNG import capacity compared with its growing demand, there may be supply deficit for NG in India of 144 -308 MMCMD. On the basis of these volumes, there could be sufficient demand to be supplied by Afghanistan or more likely a combination of Afghanistan with Turkmenistan NG.

As envisioned, the TAPI project, Figure 31, could supply 90 MMCMD, 45 MMCMD each to Pakistan and India (if there is no Afghan consumption) from Turkmenistan NG alone. One option for Afghanistan could be to substitute Afghan NG sales for one-half of the Turkmenistan NG. There would be a need to add a 360 mile NG spur from Sheberghan to intersect the planned TAPI pipeline near Herat. Alternatively, the Kabul NG pipeline could be extended 300 miles to intersect the TAPI pipeline near Kandahar but that would likely require a combination of larger diameter pipe to Kabul, more compression, and/or looping.

Figure 31: TAPI Route Map

By rationing the TAPI's US$4.6 Billion costs and the 473 mile length for Afghanistan, with the cost for the 360 mile spur to Sheberghan, the cost would be $3.5 Billion. Then dividing that cost by 1.52 (the 6/10th rule) for a pipeline that delivers 45MMCMD (½ of the TAPI 90MMCMD), the capital costs for that section would be roughly $2.3 billion dollars. The TAPI pipeline assumed a sales price of US$10/MMBTU or US$353/MCM for India and US$8.266/MMBTU or US$292/MCM. After deducting the estimated transportation tariffs of US$148/MCM for India and US$122/MCM for Pakistan, the respective wellhead prices could be US$205/MCM for India and US$170/MCM for Pakistan. Those wellhead prices appear attractive but could soften significantly based on shale gas development in China and the United States reducing global LNG demand and in turn market prices. Afghanistan would also need to establish 300 BCM of extra reserves above its domestic consumption needs to support a 20 year TAPI supply contract.

5.1 LNG

LNG can be attractive in lieu of NG pipelines where the customer is distant or the countries crossed to reach the customer present too much political risk. The scale and costs of LNG facilities have grown over time and recent projects like the Gorgon project in Northwest Australia give some cost reference numbers. That project will produce an estimated 12 million tons per annum (MTA) of LNG through a liquefaction plant costing around $15 billion. Those 12 MTA are equivalent to 15.553 BCM or 45.35 MMCMD. Typically, a number of LNG tankers are needed to move the LNG cargo to the customers, with shipbuilding costs of $200 - $250 million each. Usually off-take contracts with multiple customers are signed for the entire throughput for a 15 – 20 year term to secure financing for such a large investment. In Figure 32, there is a potential Pipeline Route Map to get the Afghan NG to the nearest large port.

Figure 32: LNG Pipeline Route Map

For an order of magnitude estimate, the 1,290 mile distance from Sheberghan to the large port city of Karachi could add pipeline costs of $8.3 Billion using the TAPI $2.3 Billion for 360 miles in Afghanistan as a cost reference. The liquefaction plant costing around $15 billion, pipeline costs of $8.3 Billion, and perhaps 8-10 LNG tankers adding a few US$ Billion more, result in prohibitively high capital costs of $25 Billion or more. Even if Afghanistan can establish the 300 BCM of extra reserves to support a 20 year supply contract, it would still be very hard to complete with other LNG producing nations, like Oman, Qatar, and Indonesia, which 1) are located on the water (with no political risk issues with possibly uncooperative neighbors), 2) have established natural gas reserves for 20 years of full LNG contract supply, 3) existing in-country pipeline systems, 4) in- country LNG liquefaction facilities, 5) stable political risk climates – gas field to LNG liquefaction/port – from the perspective of the 20 year customer, and importantly, 6) substantial LNG experience.

6 Priority Uses of NG in Afghanistan

6.1 Fertilizer Production

The Fertilizer plant in Kod-e-Barq-e Mazar-e-Sharif was built by the former Soviet Union a half century ago. It had a design capacity of 200 Metric Tons (MT) per day of ammonia (through two lines of 100 MT/day) and 300 MT per day of urea (through three lines of 100 MT/day). Over time, however, the annual production level (2012) has fallen to 25,000 MT based on a viable annual production capacity of 45,000 MT.

The plant is not mechanically efficient nor labor efficient with reportedly about one thousand employees. However, agriculture is a substantial portion of the country's GDP. Since Afghanistan is landlocked and occasionally has challenging relationships with its neighbors, having a domestic ability to produce fertilizer to support its agriculture industry and feed a population of 30 million people is important. So fertilizer production will likely remain a priority use of NG in Afghanistan and ranks as a key application of NG.

6.2 Power Generation

Regarding electricity, prior to 1978, Afghanistan was able to access approximately 396 megawatts ("MW") of domestic power generation compared to approximately 243 MW of power in 2002, at which time almost 50% came from domestic hydropower. In 2004, the Ministry of Energy and Water ("MEW") identified expanded power imports as a key medium-term strategy to address the unmet demand within Afghanistan. The summer operating capacity of Afghanistan grew to approximately 750 MW of power by 2007. In that year about one third (33%) of electrical power delivered to the grid was imported from neighboring countries. Recent improvements in energy transmission and distribution systems have facilitated a significant increase in the amount of imported power, which accounted for 70% of total power supply in 2010. Importantly, while NG is a prime fuel source for power generation in many countries, Afghanistan only has one small NG fueled power plant producing less than 20 MWs, associated with the Fertilizer plant.

A recent presidential mandate requires the development of domestic generations to meet the power needs of the country and begin to diminish its reliance on imported power. As a result of the foregoing analysis, the use of NG for power generation could deliver substantial domestic generation and provide the highest net wellhead price for domestic NG. The US$120/MCM processed NG price could deliver electric power from a 200 MW plant at an 85% dispatch rate for about US$.0707/kWh in 2015, which is relatively attractive versus expected import prices.

Further analysis is required in order to determine the likely incremental sizes and dispatch rates for the new NG fueled power plants to be built in Afghanistan. Also, there will be negotiations to work to establish the appropriate pricing for the NG sold for power production. There is a possibility of increasing the NG price, however, there is a price ceiling created by the option of importing power if it has a lower price. For example, a US$150/MCM cost of NG could deliver electric power from a 200 MW plant at an 85% dispatch rate for about US$.08/kWh in 2015 while a US$170/MCM cost of NG would deliver electric power at an 85% dispatch rate for about US$.0861/kWh in 2015. The US$.08/kWh would likely be considered a high price by DABS and US$.0861/kWh in 2015 could likely be considered totally unacceptable.

The 85% dispatch level may be too optimistic and perhaps a 60 – 70% dispatch would be more likely. With NG at the US$120/MCM and a 60 – 70% dispatch, the power price would be US$.0779/kWh and US$.0848/kWh, respectively. A US$.08/kWh power price could be the upper limit for how much the electric utility would be willing to pay in 2015.

In the Low Case scenario, power generation use presents the major consumption source of NG, with more than 56% in year 2025 of total consumption, in second place is the industrial consumption with almost 33% of the total. Regarding the consumption by region, Sheberghan would use more than 71% of the total and the rest of the consumption would come from Mazar-e-Sharif. The 200 MW power plant to be installed in Sheberghan would be the major consumer in this case, in second place are the industrial consumers in Mazar-e-Sharif, then the fertilizer plant, CNG and residential consumption.

Figure 31: Projected Demand by Sector - Low Case

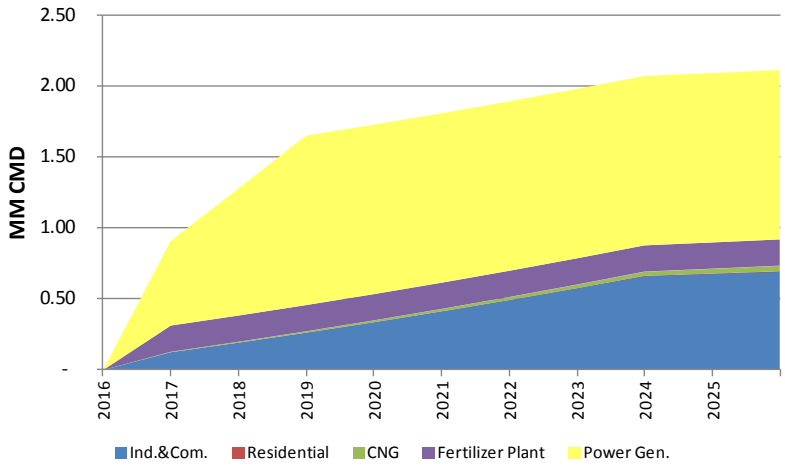
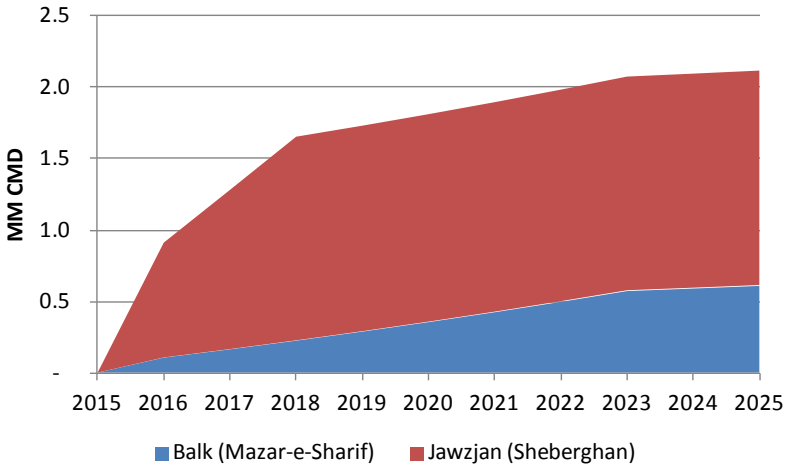


Figure 32: Projected Demand by Region - Low Case



For affordable power, increased energy security, and support for the NG industry revitalization, power generation would be a priority use and ranks as a key application of NG.

6.3 Commercial Uses

Brickmaking

There is virtually no large scale industrial production in Afghanistan, except perhaps the aggregation of the few hundred brick kilns. The conversion of those brick kilns to NG use would be attractive for the NG industry as well as an environmental improvement in the country. With the projected pricing of NG at a significant discount to domestic coal prices, the brick industry could make additional profits and perhaps expand to better serve the domestic and export markets. There may be a single brick kiln operating on NG currently in the country. Further, there may be some operational advantages in the use of coal rather than NG in "firing" the bricks, so a 30% discount in the NG price relative to coal may be required to incentivize the fuel switching. The projected consumption by brick kilns is substantial and helps support the pipeline to Kabul, so this remains a priority application of NG.

Glass Production

There is currently no significant glass and glassware production in Afghanistan. All glass for residential and commercial construction is currently imported, so the creation of a factory in Afghanistan for plate glass might be viable. The reported figure of a US$43 million cost does appear to be challenging from a fund raising perspective in view of the current financial situation of the country. If the necessary raw materials are available in sufficient quantities and at reasonable prices, then the glass factory could be viable and sustainable use of domestic NG for melting and fabricating.

CNG

Regarding the estimation of future demand for CNG, Table 25 presents the main assumptions used to project the demand on NG for this sector. First, the total number of gasoline vehicles is about 284,000 and a reasonable target is the conversion of 20% in 10 years and 30% in 15 years of the gasoline vehicles. Ultimately, over about 85,000 vehicles would be converted to CNG over 15 years. In the Low Case the annual consumption of NG in 2025 would only reach about 38MCMD while the consumption in the Case 1, 2 and 3 would reach 317 MCMD in 2025 and 475 MCMD in 2030. The volume levels for Case 1, 2 and 3 would make CNG a priority use.

Bakeries, Restaurants, etc.

A conversion of the commercial food preparation from LPG and some coal to use NG is a relatively significant forecast usage of NG. Generally, little or no conversion costs are involved other than perhaps the NG interconnection costs. It was assumed that commercial operations such as Bakeries, Restaurants, etc., could afford those costs in order to recognize the cost savings over LPG usage.

Summary

Results of Case 1 are presented in Figure 31 and Figure 32, and are fairly similar in consumption patterns to the Case 2 and 3 analyses. These results are disaggregated by type of consumer and region. As may be expected, the Kabul region represents an important part of the total consumption, by 2025 the demand in this region could represent 68% of total, Sheberghan more that 18% and Mazar-e-Sharif almost 8%. Regarding the demand by sector, the industrial and commercial sectors represent 63.7% of total and power 29.5%. Further, the industrial and commercial demand of Kabul is almost 50% of the total demand. Therefore, it is possible to build a pipeline to Kabul to serve both those sectors due to their strong demand while offering relatively modest prices for other consumers and adequate returns for the NG producers, the pipeline operator and LDC investors.

For support of the NG pipeline system and the NG industry revitalization, and environmental benefits, commercial and industrial uses would be a priority use and rank as a key application of NG.

Figure 33: Projected Demand by Sector - Case 1e

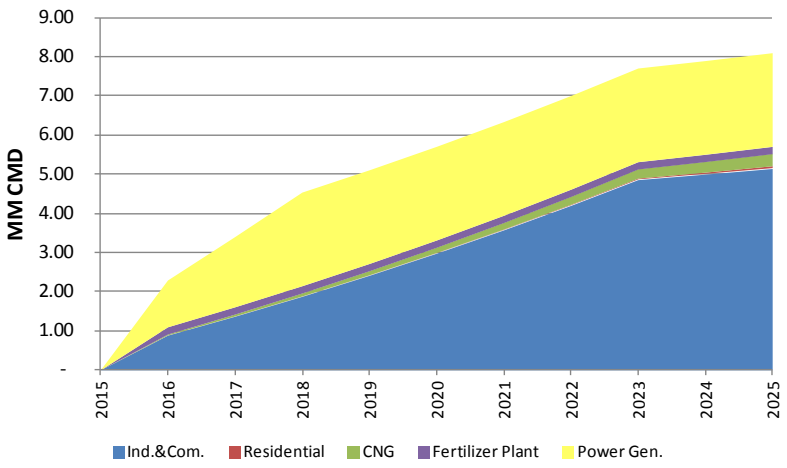
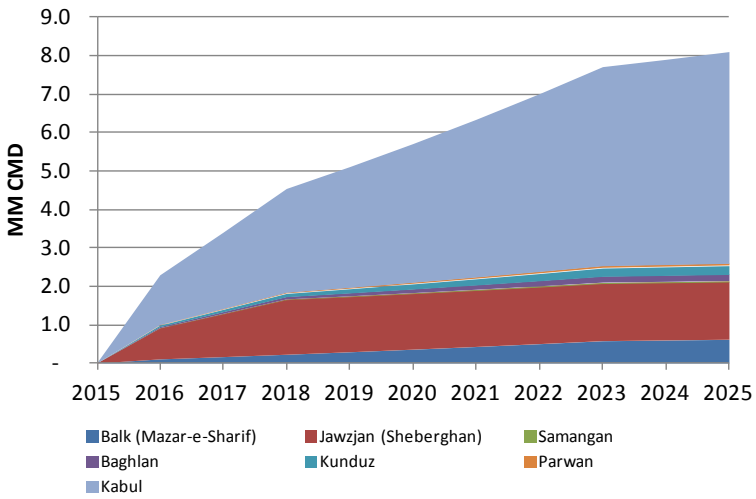


Figure 34: Projected Demand by Region - Case 1



6.3.1 Residential Use (Cooking and Heating)

One noteworthy observation from Figure 31 above is the low participation of the residential and CNG sectors. It may be argued that this result was already assumed since the market participation of NG in the LPG and gasoline markets are low. Even with high profit margins available to LDC for LPG replacement, the residential sector will not be expected to increase substantially their market share because the average consumption of LPG by families is too low on a relative basis. While some LPG conversions of residential cooking was assumed since it does not involve much conversion cost, the use of NG for heating was not included since it does require high conversion costs, and so not were assumed to occur often.

Moreover, generally in the first years of a new NG market, typically the power generation and industrial sector are important, then, after some years, the residential consumption starts growing because: 1) the

LDC has the cash flow to interconnect residential consumers and 2) the consumption of NG becomes well known in the region.

For environmental benefits but a relatively low market share by the residential sector for primarily cooking, this use would be a moderate priority use and rank as a valuable application of NG.

6.3.2 Gas Export

As previously discussed, there are threshold questions for pipeline export of NG: 1) adequate reserves, 2) competitive final prices and 3) reliable political arrangements with the countries that would participate in the project.

The answer to the first question is that the current level of P1 is not large enough to consider the export markets in the near term. It may be possible in the next 2-5 years to verify adequate P1. The answer to the second question may to be positive but competitive final prices will be a function of the transportation system costs plus acceptable well head prices.

The TAPI project could be the catalyst for Afghanistan to participate in the supply of 90 MMCMD or more to Pakistan and India. One option could be for Afghanistan to substitute Afghan NG sales for one-half of the Turkmenistan NG. The Afghan NG could be supplied with or without the Kabul pipeline project. The rough estimate capital costs for that section would be about $2.3 billion dollars. If the TAPI pipeline assumed NG sales prices of US$10/MMBTU or US$353/MCM for India and US$8.266/MMBTU or US$292/MCM are deemed solid, despite shale gas price pressures, then the project could be viable. The resulting wellhead prices could be US$205/MCM for India and US$170/MCM for Pakistan. However, the final capital costs of the TAPI would then exceed US$10 billion and the task to finance such a four country project with their rocky past and current relations would be a herculean effort.

Since the TAPI project with Afghan NG sales could be a valuable source of employment, would help in the development of a nationwide gas pipeline system, provide essential foreign exchange, and could stimulate improved political relations with neighboring countries, it would definitely be considered a priority use of NG when adequate reserves are established and would rank as a key application.

6.3.1 LNG

With the location of the Sheberghan gas fields being 1,290 mile distance from a potential LNG site in the large Pakistani port city of Karachi, there would be substantial pipeline costs of about $8.3 Billion to just move the NG to the gas liquefaction plant. The LNG business is highly competitive and a plan to locate an LNG facility in a different country than the source for the NG would create a new precedent. Given the sometimes challenging relationship between Pakistan and Afghanistan as well as Pakistan's current energy deficit, it would not be sensible to seriously consider an LNG project for export only, until the political relationship between the countries has improved dramatically and the Pakistani energy deficit has been reasonably addressed.

Even if the Pakistani issues were resolved, the $8.3 billion hurdle to get the Afghan NG to the LNG site appears to create too large of a capital cost adder in order for that project to compete on a price basis with other projects like those in Oman, Qatar, Indonesia, etc., which are already located on or near oceans and have good LNG track records. Therefore, without a dramatic change in circumstances, the priority consideration of Afghan NG for LNG should be deemed very low and not rank as an important application.

7 Conceptual Roadmap for the Development of Gas Utilization

This roadmap section endeavors to answer the question of "how to move the gas from field to potential future customers" in a commercially viable and sustainable manner to re-vitalize the NG industry in Afghanistan. From the SGGA perspective, the first step is to facilitate the completion of the Sheberghan Gas Development Project, SDGP, specifically the well drilling and gas processing tenders awards/performance as well as the full execution of the Independent Power Plant contract documents: Gas Supply Agreement and the Power Purchase Agreement. From there the commercial viability of the SGDP restarted gas fields' development can be established by understanding the available upstream mechanisms to facilitate more exploration, especially the means for setting the well head prices to attract private investors for exploration and production with the objective to establish and maintain a sustainable gas development industry.

1) Establish the appropriate MoMP structure(s) and institutional capability
2) Successfully complete the SGDP and the new Yatimtaq and Gerquduq field projects
3) Implement the GIRoA policy for energy security through domestic generation using NG
4) Design supportive NG pricing for each end-user energy market segment
5) Identify and Mobilize Stakeholders
6) Identify the projects within market segments that meet the high priorities and are commercially viable and sustainable
7) For each high priority project ensure
    a) Private enterprises can implement their part
    b) Any needed donors are identified and committed
8) Ensure economic interests of all parties are aligned for sustainability
9) Implement

This roadmap is consistent with the prior roadmap work by AEAI for the Afghan gas industry revitalization. It will require the effort and cooperation of various local and foreign stakeholders to agree on concepts, advance concepts to agreements, and then implement those agreements. The stakeholder interest groups can be broadly categorized as the following:

<u>Central Government</u>

The GIRoA stakeholder group, which includes the ministries that oversee the energy sector in Afghanistan, must perform their respective roles in a balanced and cooperative manner to continue in moving these projects forward. The key stakeholders in this group include:

- Ministry of Mines & Petroleum
- Ministry of Energy and Water
- Da Afghanistan Breshna Sherkat
- Ministry of Finance
- National Environmental Protection Agency (NEPA)

Their primary responsibility will be to ensure the development of the GIRoA support for future projects, such as Single Windows approach for hydrocarbon or power projects. The GIRoA entities must facilitate the navigation of the investors and lenders to access essential planning information, compliance with all applicable laws and regulations, and minimizing government hurdles for project implementation. One key area to resolve will be the pricing for the hydrocarbon sales and the "government take".

Donors, International Financial Institutions, and Other Lenders

This group has the capability to provide critical support to:

1) fund technical assistance and capacity building reform projects as well as provide grants to central and local governments that will complement targeted investments;
2) provide long-term low interest loans to the central government and investors for the development and rehabilitation of energy infrastructure; and
3) offer political risk insurance, financial incentives and other types of financial instruments to investors that serve to mitigate the risks for investments.

The key stakeholders in this group could include:

- U.S. Agency for International Development
- Asian Development Bank
- Kreditanstalt für Wiederaufbau
- The World Bank
- Overseas Private Investment Corporation
- Multilateral Investment Guarantee Agency
- Afghanistan Investment Guarantee Facility
- Islamic Development Bank, and
- International Finance Corporation

These stakeholders will be needed to provide or facilitate funds for feasibility studies, investment capital, and other uses to foster new project developments or project rehabilitations to meet the country's energy needs.

Potential Investors

This group includes various types of investors, ranging from fully or partially government-owned institutions and enterprises, to non-governmental organizations, to privately held concerns. Some investors are in the business to develop and operate investments, such as international oil and gas companies and independent power producers (IPPs). Other investors, however, may or may not have direct oil and gas or electric power industry expertise, but have raised funds for large international investments. The Aga Khan Foundation is one example of a private, not-for-profit international development agency that has indicated an interest in the Afghan energy sector. This latter group of investment and financial organizations may subcontract out to industry specialty firms to manage and conduct all technical operations. Generally, investment and financial organizations, as a business, arrange these investments for acquisition by industry companies with the expertise in sector operations and additional risk capital.

Local Governments, Community Leaders, Influential Parties, and Customers/Citizenry:

This is the most important group since the federal system in Afghanistan is weak and the project implementation and contract enforcement will depend heavily on the locals to support the terms and conditions of the project agreements and licenses that will likely be negotiated in Kabul. This group includes:

1) the provincial and municipal local governments in the Sheberghan and other NG producing areas;
2) those organizations and individuals that wield influence over the nature of investments, security services, business development, and social and economic growth in the current and future NG producing regions as well as in high priority gas markets; and

3) the customers (industrial, commercial, and residential) that demand these resources and, thus, are ultimately responsible for making the payments for gas development, gas and electric power generation services (as well as transmission and distribution) and supplies.

Energy in the form of gas and electric power is required for economic growth and is needed by all the members of this group to improve their lives and livelihoods. Affordability and sustainability are key criteria, and assurances must be made to ensure reasonable cost of services and reliable supplies, while permitting a reasonable return on investment in order to provide maintenance and expansion of supplies.

Stakeholders Synergy

All four stakeholder interest groups can benefit from the development of the existing gas fields and construction and operation of gas-fired electric power plants. The central government, local government and influential parties should demonstrate their ability to establish an attractive environment for long-term private domestic and international investment, provide training and capacity building for newly established industries and create sustainable employment opportunities for Afghan citizens. This will increase confidence within the NG producing regions in the ability of the central and local governments to coordinate investment and complete infrastructure projects. The Donors agencies, International Financial Institutions (IFIs) and other lenders can provide technical and financial assistance in the form of grants, loans and financial instruments to central and local governments for projects that will lay a better foundation and present a better environment for current and potential investors to make significant further investments in a variety of industries and customer-related businesses. Thereby, credibility would be gained by the central and local governments, and more importantly, with the public in the Sheberghan region.

Potential investors have the opportunity to be 'first-in' for the gas-fired power plants, which, based upon need and market potential, has the prospect of offering additional investment opportunities. With central and local government leadership setting a favorable environment for investment, demand for gas and electric power should experience considerable growth with time, due to the creation of new markets, which depend upon reliable and low cost energy supplies. Shareholders of current and potential investors should also benefit with returns based upon investment risk and overall market expansion. If managed properly and closely coordinated, all should benefit with economic growth and employment.

8 Proposed Institutional Structure for an Expanded Gas Market in Afghanistan with Appropriate Roles of GIRoA and the Private Sector Defined

The following are general concepts on how the MoMP could re-align policy, commercial, and regulatory functions in keeping with the overall policy of the Minister and the Government.

At present the Ministry carries out three key hydrocarbon sector functions – sovereign functions (such as tendering and awarding contracts under the Hydrocarbon Law), commercial activity (such as Afghan Gas Enterprise's operation of the NG fields and infrastructure), and regulation. The separation of commercial functions has been initiated recently by a request to the Cabinet to authorize the conversion of Afghan Gas Enterprise ("AGE") into a State-owned commercial corporation.

The planning process for the separation and more clear definition of the MoMP's remaining policy, sovereign, and regulatory functions is ongoing. Each of these functions and a conceptual description of how they can be organized are discussed below. All possible models are not presented, rather just those that appear to SGGA to be the most suitable for the current realities of the Afghan hydrocarbon sector are described. These are not the only possible approach, but at a minimum can serve as a basis for discussion, further investigation, and further elaboration.

Summary Recommendations

In summary, the recommendations are as follows:

Although the process of separating the MoMP's commercial functions has begun, and the resulting corporate structure will be defined by law, the following key issues should be addressed in the course of establishing the new company:

- Assuring that all relevant assets, including known but currently non-producing fields, be transferred to the new company
- Assuring that the new company receives all necessary rights, licenses, and other assets to be able to operate effectively as a stand-alone petroleum company with the ability to enter into industry transactions
- Consideration of including the functions, personnel, and assets of the MoMP's Northern Hydrocarbon Unit in the new company in order to assure that the new company has the assets and capabilities it needs to operate effectively as a stand-alone petroleum company.

The MoMP should consider establishing a separate division or department within the MoMP to regulate the technical, safety, and environmental aspects of oil and gas operations, including exploration, production, transportation, gas processing, and oil refining.

The MoMP should continue to exercise its core sovereign functions of tendering and awarding hydrocarbon contracts, managing the commercial aspects of such hydrocarbon contracts, promoting the development of the Afghan hydrocarbon industry, and developing and implementing national hydrocarbon policy.

Commercial Operations Discussion

The MoMP currently has two main hydrocarbon sector commercial departments or divisions, the Northern Hydrocarbon Unit ("NHU"), historically responsible for oil and gas (principally gas) exploration, and AGE, responsible for gas production and sales. In early 2012, the MoMP and MoF issued a proposal to convert AGE to a State-owned commercial corporation through the process defined in the Law on Governmental Enterprises. The proposal has been submitted to the Cabinet and is awaiting Cabinet action.

The process for the change of legal form is prescribed by law, as described generally in the Ministries' proposal. As head of the current operational ministry, it is expected that the Minister of Mines and Petroleum will have a seat on the new corporation's governing body.

The proposal emphasizes that a major advantage of converting AGE to a commercial corporation (for which the name Afghan Petroleum Corporation (APC) has been suggested and is used here) would be to provide the flexibility to enter into commercial arrangements not readily available to a governmental unit. SGGA suggest that in establishing APC, the MoMP should:

- consider incorporating the Northern Hydrocarbon Unit's functions, assets, and key personnel into APC to assure that these resources are available for APC's commercial operations.

- assure that all licenses, operating, and production rights and associated assets are transferred to APC so that it can function effectively as oil and gas firm (for example, by being able to enter into standard industry arrangements such as farm-out agreements, joint ventures, etc., to maximize development of reserves) without being unnecessarily burdened by governmental constraints appropriate to government bodies but not commercial organizations.

Further, the MoMP will need to assess what responsibilities APC might assume in the operational management of production sharing agreements and other State hydrocarbon contracts. In many countries, the national oil company has a significant role in such contracts. It is not necessarily clear that assigning a key role to the national company is the best option, but the option should be examined.

Regulatory Functions

Although frequently promoted by international donors, there is currently no legislation that establishes an "independent" regulatory body for the hydrocarbon sector. The current Hydrocarbon Law and Hydrocarbon Regulations provide adequate basis for establishing a better defined regulatory function within the MoMP.

The justification for creating a separate regulatory agency is questionable. Even with the recent rapid increase in hydrocarbon exploration and production activity, the number of oil and gas contractors/operators in the country is small, and will likely remain so due to the MoMP's policy of establishing geographically large blocks for exploration and development. While more wells and operations will increase the need for field inspectors and middle-level managers to oversee this activity, the limited number of contractors does not at this time justify the lengthy process of enacting legislation and setting up a new independent agency, preparing and issuing new regulations, and recruiting, training, and paying the additional officials, senior managers, and line personnel that would be required.

Instead, better defining and organizing the MoMP's regulatory functions is preferable, certainly in the mid- to long-term of three to ten years. The MoMP will be able to draw on existing experienced personnel, such as those in its Inspectorate, build on its existing regulatory framework, and internally re-structure expeditiously. The need for an independent regulator can be reviewed as the Afghan hydrocarbon industry develops.

A key step in better defining the MoMP's regulatory function is spelled out its jurisdiction. In order to assure effective regulation of the sector, the inclusion of the following in MoMP's regulatory jurisdiction should be considered:

- Health, safety, and environmental standard-setting and compliance, both statutory and contractual. Ideally, this should include full authority over all hydrocarbon activities. Full inclusion might require reaching agreements with other governmental with overlapping jurisdiction agencies (e.g., NEPA) to delegate sectorial responsibility to the MoMP, or new legislation assigning exclusive jurisdiction to the MoMP.
- Oil and gas conservation through setting of maximum efficient production rates, unitization (voluntary and mandatory), reservoir development regulations, and best practices requirements for production.
- Pipeline and other oil and gas transportation operations, including tariff and access requirements for common use facilities.
- Gas processing and oil refining licensing and permitting.
- Resolution of disputes between operators in these areas.

In exercising regulatory functions, the MoMP will need to establish that it can act with both actual and perceived fairness, particularly when the MoMP's own policies and related operations (such as APC) might be involved. This will require close attention to conflict of interest issues and the establishment of clear and consistently applied administrative procedures. A new regulatory division could incorporate existing MoMP departments, such as the Inspectorate.

Sovereign Ministry Functions

As its commercial functions are separated and regulatory role re-aligned, the MoMP can more clearly define its sovereign and policy roles in the hydrocarbon sector. These core functions will almost certainly include:

- Establishing and implementing long-term State hydrocarbon policy
- Setting terms for and issuing hydrocarbon exploration, production and transportation contracts
- Managing the State's interest in exploration and development contracts, to the extent such functions are not delegated to APC
- Regulating hydrocarbon production for economic purposes, such as price stability (as opposed to setting technical, conservation-based production rates, which should remain a regulatory function)
- Overseeing the operations of the State-owned hydrocarbon companies, such as APC, through their governing bodies, as provided by law or the company charters and statutes.
- Collecting and maintaining geological, geophysical, and production data, probably at the Afghan Geological Survey.
- Promote development of the Afghan hydrocarbon industry and Afghan hydrocarbon policy internationally.

9 Conclusions

The main conclusions of this report are:

Demand

Demand for energy in Afghanistan follows the general trend observed in developing countries with some unique features. In most developing countries, energy consumption is likely to increase dramatically, due to the improvement of living standards, population growth, rapid urbanization and the gradual substitution of commercial energy for non-commercial sources. Traditionally, demand for hydrocarbons products was never very high due to weakness of economic development of the country, but during the three past decades, two factors have boosted the demand: military demand and GDP growth.

Three issues influence hydrocarbons demand: residential (especially for cooking and heating, power generator), transportation and commercial/industrial needs. In Afghanistan, the demand of the three elements is growing, usually associated with rising GDP, despite the oil price increase. Residential and commercial/industrial demand is growing, in particular, in urban area. Demand for transportation is most significantly affected by military demand. So the reduction of that military demand is expected in the future and would lead to a notable decline in total demand.

Several factors facilitated LPG's demographic growth, i.e. growth of demand; growth of income; lack of other kinds of suitable energy; urbanization; transport facilities, especially in area with difficult access; simplicity of use; regulatory measures imposed on the commercial and light industries sector; and its relative cheaper price than wood for urban households.

The nature and level of demand for goods and services are based on several factors, including the population growth, the number of people per household, the preferences of population for different form of energy, national priorities in terms of development of certain industries or economic sectors, the penetration of new technologies or forms of energy in the market, etc.

Using the Economic Model created by SGGA, an IRR of 20% for the investment in the drilling and processing plant can be obtained from a US$120/MCM price for the NG for power generation near the known NG fields in the Sheberghan area. In addition to power generation, the sources of energy that can be readily replaced by the access to NG in Afghanistan are: 1) coal used in main industries; 2) LPG used in small food industries; 3) LPG used by families (households) especially for cooking; and 4) gasoline used by cars (vehicles) as fuel.

Proposed Pricing

In this Report, the proposed final consumer price of the NG would be dependent on the energy source that will be replaced and would include a 30% discount. If the NG has to replace gasoline, then the maximum consumer price of NG has to be US$636/MCM; in the case of coal the maximum price would be US$182/MCM; and to replace LPG the price would be US$517/MCM. The 30% discounts are assumed necessary to induce consumers to switch fuels as well as to counter competitive price responses by those alternate fuel suppliers.

Development Scenarios

Building upon previous studies about the development of NG market in Afghanistan, this report will evaluate the conditions in the urban areas of the following regions: 1) Balk (Mazar-e-Sharif); 2) Jowzjan (Sheberghan); 3) Samangan; 4) Baghlan; 5) Kunduz; 6) Parwan (Charikar) and; 7) Kabul.

This Report considers four scenarios:

1) Low Case: this scenario consist in supply with NG to Sheberghan and Mazar - E - Sharif and the installation of a Power Plant of 200 MWs in Sheberghan, very close to the fields,
2) Case 1: in this scenario the supply of NG will be from Sheberghan to Kabul and to Kunduz, one Power Plant in Sheberghan of 200 MWs and another Power Plant in Kabul of 200 MWs;
3) Case 2: in this scenario the supply of NG will be from Sheberghan to Kabul and to Kunduz, one Power Plant in Sheberghan of 200 MWs and another Power Plant in Kabul of 400 MWs;
4) Case 3: in this scenario the supply of NG will be from Sheberghan to Kabul and to Kunduz and include Power Plants in Sheberghan of 600 MWs.

The following Table 56 presents the transportation tariffs and average wellhead prices for each one of the scenarios considered in the Report.

Table 56: Projected Transport Tariffs and Wellhead Prices

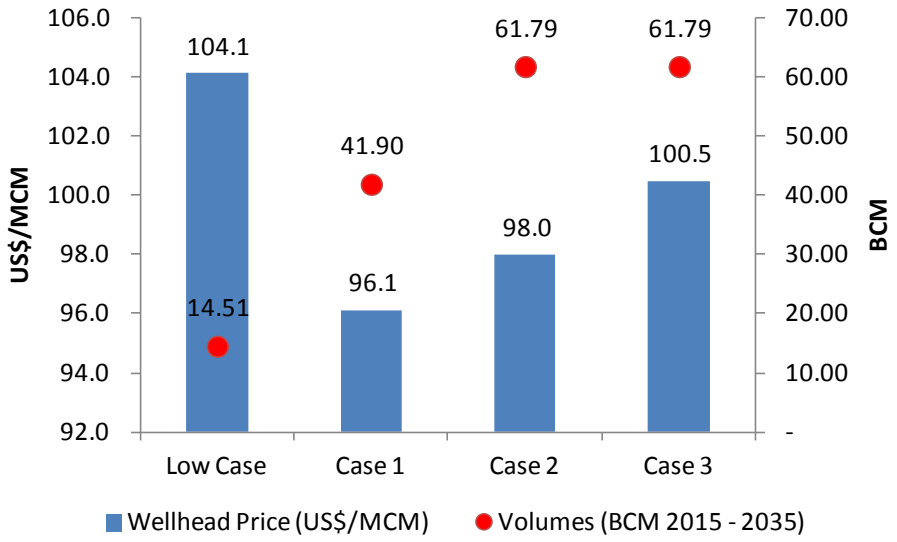
Scenarios	Project	Competitive Price (US$/MCM)	Distribution: Opex+Capex +Tax+Profit (US$/MCM)	Price City Gate (US$/MCM)	Transport: Opex+Capex +Tax+Profit (US$/MCM)	Wellhead Price (US$/MCM)
Low Case	Distribution North	181.8	46.9	135.0	41.1	93.9
	PP 200 MW Sheberghan	120.0	-	-	-	120.0
	Fertilizer Plant	34.8	-	-	-	34.8
Case 1	PP 200 MW Sheberghan	120.0	-	-	-	120.0
	Distribution North - Kabul	182.8	34.7	148.1	48.4	99.7
	PP 200 MW Kabul	120.0	-	-	48.4	71.6
	Fertilizer Plant	34.8	-	-	-	34.8
Case 2	PP 200 MW Sheberghan	120.0	-	-	-	120.0
	Distribution North - Kabul	182.8	34.7	148.1	42.5	105.6
	PP 400 MW Kabul	120.0	-	-	42.5	77.5
	Fertilizer Plant	34.8	-	-	-	34.8
Case 3	PP 600 MW Sheberghan	120.0	-	-	-	120.0
	Distribution North - Kabul	182.8	34.7	148.1	61.1	87.0
	Fertilizer Plant	34.8	-	-	-	34.8

In order to understand better the results, some observations should be made:

1) Since the fertilizer plant does benefit the entire country, it would be exempted from the transportation tariffs – no change from present status;
2) Similarly the new Sheberghan power plants (200 MW in Case 1 and 600 MW in Case 3) and in the Low Case would not pay the transport cost since the NG facilities supplying the power plants would not use the pipeline system and power may be widely used by the public, which will also pay the power transmission tariff;
3) In Cases 1, 2 and 3, the volumes for the distribution system (in all the Provinces considered in the Report) will pay the distribution margin and the transport cost;
4) The assumed power plant in Kabul (200 MW in case 1 and 400 MW in case 2) will pay the transport tariff since there is very substantial capital investment for gas transportation but the power is consumed in Kabul and those consumers do not pay much, if any, power transmission costs;
5) The competitive prices presented for the distribution sector (including industrial, CNG and residential demand) are the weighted prices for each LDC; and
6) The Wellhead Prices presented are the weighted average of the demand by the all sectors.

The results for well head prices and cumulative volume (for the period 2015 - 2035) are summarized in the following Figure 38, for each scenario.

Figure 35: Cumulative Gas Sales and Wellhead Prices



Some observations can be made about these main results:

1) The Low Case offers the highest wellhead price but on substantially lower volumes;
2) Case 1 presents lower price and volumes (relative to Cases 2 and 3) because it only considers a 200 MW additional plant in Kabul, so the wellhead price is lower because the transport cost is higher;
3) Cases 2 and 3 present the highest and equal volumes (there's a 600 MW generation in both alternatives) but, in case 3 the wellhead price is higher because the NG volumes used in Sheberghan to generate the additional 600 MW doesn't pay any transport cost.

Wellhead Prices

After analyzing all the statistics, one of the main conclusions of the study is that the energy market for the country is open with relatively low prices. That is, in the short term, the internal market is the fast and quick way to develop the NG reserves, nevertheless, the price of alternatives sources of energy and the cost to develop infrastructure to supply NG the industrial, commercial, CNG, residential and power generation is high. For that reason, the expected wellhead price is between US$100 and $130 /MCM, which is a reasonably good price for a developing country like Afghanistan. The low cost of coal in the country puts a ceiling on the energy prices since a substantial portion of the industrial energy matrix relies upon coal.

Exporting NG via a pipeline to Pakistan and India offers some higher wellhead prices but first additional reserves must be verified, political issues resolved, and billions of investment dollars raised.

Roadmap

The development roadmap to facilitate this work includes the following steps:

1) Establish the appropriate MoMP structure(s) and institutional capability
2) Successfully complete the SGDP and the new Yatimtaq and Gerquduq field projects
3) Implement the GIRoA policy for energy security through domestic generation using NG
4) Design supportive NG pricing for each end user energy market segment
5) Identify and Mobilize Stakeholders
6) Identify the projects within market segments that meet the high priorities and are commercial viability and sustainability
7) For each high priority project ensure

   a. Private enterprises can implement their part
   b. Any needed donors are identified and committed
8) Ensure economic interests of all parties are aligned for sustainability
9) Implement

Proposed Institutional Structure

It is preferable for the MoMP to re-align policy, commercial, and regulatory functions in keeping with the overall policy of the Minister and the Government.

The separation of commercial functions has been initiated recently by a request to the Cabinet to authorize the conversion of Afghan Gas Enterprise ("AGE") into a State-owned commercial corporation. That process should be continued in a manner to produce an entity with the all licenses, operating, and production rights, appropriate assets, qualified staff, and operational latitude to be successful.

The MoMP should consider establishing a separate division or department within the Ministry to regulate the technical, safety, and environmental aspects of oil and gas operations, including exploration, production, transportation, gas processing, and oil refining. Such regulatory authority should cover health, safety, and environmental standard-setting and compliance, both statutory and contractual. Ideally, this should include full authority over all hydrocarbon activities. Full inclusion might require reaching agreements with other governmental with overlapping jurisdiction agencies (e.g., NEPA) to delegate sectorial responsibility to the MoMP, or new legislation assigning exclusive jurisdiction to the MoMP.

The MoMP should exercise its core sovereign functions of tendering for and awarding hydrocarbon contracts, managing the commercial aspects of such hydrocarbon contracts, promoting the development of the Afghan hydrocarbon industry, and developing and implementing national hydrocarbon policy. These core functions will almost certainly include:

- Establishing and implementing long-term State hydrocarbon policy
- Setting terms for and issuing hydrocarbon exploration, production and transportation contracts
- Managing the State's interest in exploration and development contracts, to the extent such functions are not delegated to APC
- Regulating hydrocarbon production for economic purposes, such as price stability (as opposed to setting technical, conservation-based production rates, which should remain a regulatory function)
- Overseeing the operations of the State-owned hydrocarbon companies, such as APC, through their governing bodies, as provided by law or the company charters and statutes.
- Collecting and maintaining geological, geophysical, and production data, probably at the Afghan Geological Survey.
- Promoting development of the Afghan hydrocarbon industry and Afghan hydrocarbon policy internationally.

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Central Statistics Organization

Ministry of Commerce

Ministry of Finance

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Annex 1: Natural Gas Demand Projections

Volumes: Balk (Mazar e Sharif)												
Sector	**Unit**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Ind. & Com.	MM CF	-	1,326.0	2,040.2	2,787.1	3,567.9	4,383.7	5,235.7	6,125.2	7,053.4	7,224.0	7,398.7
Residential	MM CF	-	2.9	3.9	5.3	7.1	9.5	12.8	17.1	22.9	30.7	41.2
CNG	MM CF	-	38.4	79.2	122.2	167.8	215.9	266.7	320.2	376.8	436.3	499.1
Total	**MM CF**	**-**	**1,367.4**	**2,123.3**	**2,914.7**	**3,742.8**	**4,609.0**	**5,515.1**	**6,462.5**	**7,453.1**	**7,691.1**	**7,939.0**
Ind. & Com.	MM CM	-	37.5	57.7	78.8	100.9	123.9	148.0	173.1	199.4	204.2	209.2
Residential	MM CM	-	0.1	0.1	0.1	0.2	0.3	0.4	0.5	0.6	0.9	1.2
CNG	MM CM	-	1.1	2.2	3.5	4.7	6.1	7.5	9.1	10.7	12.3	14.1
Total	**MM CM**	**-**	**38.7**	**60.0**	**82.4**	**105.8**	**130.3**	**155.9**	**182.7**	**210.7**	**217.4**	**224.4**
Ind. & Com.	M CM	-	37,483.3	57,673.6	78,788.2	100,859.5	123,920.5	148,005.6	173,150.0	199,390.1	204,212.1	209,150.7
Residential	M CM	-	83.1	111.5	149.5	200.4	268.8	360.4	483.4	648.2	869.2	1,165.6
CNG	M CM	-	1,086.7	2,238.0	3,455.2	4,742.7	6,101.8	7,538.1	9,053.0	10,650.7	12,334.1	14,108.8
Total	**M CM**	**-**	**38,653.1**	**60,023.0**	**82,393.0**	**105,802.6**	**130,291.1**	**155,904.1**	**182,686.3**	**210,689.0**	**217,415.5**	**224,425.1**
Ind. & Com.	BCM	-	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
Residential	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**BCM**	**-**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**
Ind. & Com.	MM CFD	-	3.6	5.6	7.6	9.8	12.0	14.3	16.8	19.3	19.8	20.3
Residential	MM CFD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
CNG	MM CFD	-	0.1	0.2	0.3	0.5	0.6	0.7	0.9	1.0	1.2	1.4
Total	**MM CFD**	**-**	**3.7**	**5.8**	**8.0**	**10.3**	**12.6**	**15.1**	**17.7**	**20.4**	**21.1**	**21.8**
Ind. & Com.	MM CMD	-	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.6
Residential	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**MM CMD**	**-**	**0.1**	**0.2**	**0.2**	**0.3**	**0.4**	**0.4**	**0.5**	**0.6**	**0.6**	**0.6**
Ind. & Com.	M CMD	-	102.7	158.0	215.9	276.3	339.5	405.5	474.4	546.3	559.5	573.0
Residential	M CMD	-	0.2	0.3	0.4	0.5	0.7	1.0	1.3	1.8	2.4	3.2
CNG	M CMD	-	3.0	6.1	9.5	13.0	16.7	20.7	24.8	29.2	33.8	38.7
Total	**M CMD**	**-**	**105.9**	**164.4**	**225.7**	**289.9**	**357.0**	**427.1**	**500.5**	**577.2**	**595.7**	**614.9**

Volumes: Jawzjan (Sheberghan)												
Sector	**Unit**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Ind. & Com.	MM CF	-	288.1	441.4	600.5	765.6	936.8	1,114.3	1,298.2	1,488.8	1,518.5	1,548.9
Residential	MM CF	-	3.5	3.9	4.3	4.8	5.4	6.1	6.8	7.6	8.5	9.5
CNG	MM CF	-	2.1	4.3	6.7	9.2	11.8	14.6	17.5	20.6	23.9	27.3
Total	**MM CF**	**-**	**293.6**	**449.6**	**611.6**	**779.6**	**954.0**	**1,134.9**	**1,322.5**	**1,517.0**	**1,550.9**	**1,585.7**
Ind. & Com.	MM CM	-	8.1	12.5	17.0	21.6	26.5	31.5	36.7	42.1	42.9	43.8
Residential	MM CM	-	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3
CNG	MM CM	-	0.1	0.1	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8
Total	**MM CM**	**-**	**8.3**	**12.7**	**17.3**	**22.0**	**27.0**	**32.1**	**37.4**	**42.9**	**43.8**	**44.8**
Ind. & Com.	M CM	-	8,143.1	12,477.8	16,975.9	21,642.2	26,481.4	31,498.4	36,698.4	42,086.4	42,927.2	43,784.7
Residential	M CM	-	97.9	109.5	122.4	137.0	153.2	171.3	191.6	214.4	239.8	268.2
CNG	M CM	-	59.0	122.1	189.5	259.7	334.2	412.8	495.6	582.7	675.3	772.2
Total	**M CM**	**-**	**8,299.9**	**12,709.4**	**17,287.9**	**22,038.9**	**26,968.7**	**32,082.6**	**37,385.6**	**42,883.4**	**43,842.3**	**44,825.1**
Ind. & Com.	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Residential	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**BCM**	**-**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Ind. & Com.	MM CFD	-	0.8	1.2	1.6	2.1	2.6	3.1	3.6	4.1	4.2	4.2
Residential	MM CFD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CFD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Total	**MM CFD**	**-**	**0.8**	**1.2**	**1.7**	**2.1**	**2.6**	**3.1**	**3.6**	**4.2**	**4.2**	**4.3**
Ind. & Com.	MM CMD	-	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Residential	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**MM CMD**	**-**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**
Ind. & Com.	M CMD	-	22.3	34.2	46.5	59.3	72.6	86.3	100.5	115.3	117.6	120.0
Residential	M CMD	-	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7
CNG	M CMD	-	0.2	0.3	0.5	0.7	0.9	1.1	1.4	1.6	1.9	2.1
Total	**M CMD**	**-**	**22.7**	**34.8**	**47.4**	**60.4**	**73.9**	**87.9**	**102.4**	**117.5**	**120.1**	**122.8**

Volumes: Samangan												
Sector	**Unit**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Ind. & Com.	MM CF	-	71.8	107.9	144.0	180.2	216.3	252.4	288.5	324.7	324.9	325.2
Residential	MM CF	-	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.1	0.1
CNG	MM CF	-	0.4	0.9	1.3	1.8	2.3	2.9	3.4	4.0	4.7	5.3
Total	**MM CF**	**-**	**72.7**	**109.2**	**145.7**	**182.3**	**218.9**	**255.5**	**292.2**	**328.9**	**329.7**	**330.6**
Ind. & Com.	MM CM	-	2.0	3.1	4.1	5.1	6.1	7.1	8.2	9.2	9.2	9.2
Residential	MM CM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CM	-	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.2
Total	**MM CM**	**-**	**2.1**	**3.1**	**4.1**	**5.2**	**6.2**	**7.2**	**8.3**	**9.3**	**9.3**	**9.3**
Ind. & Com.	M CM	-	2,028.7	3,050.0	4,071.4	5,092.7	6,114.1	7,135.4	8,156.8	9,178.1	9,185.2	9,192.2
Residential	M CM	-	14.1	11.9	10.1	8.6	7.3	6.2	5.3	4.5	3.8	3.2
CNG	M CM	-	12.6	25.3	37.9	51.9	66.0	81.4	96.9	113.7	132.0	150.2
Total	**M CM**	**-**	**2,055.4**	**3,087.2**	**4,119.4**	**5,153.3**	**6,187.4**	**7,223.1**	**8,258.9**	**9,296.3**	**9,320.9**	**9,345.6**
Ind. & Com.	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Residential	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**BCM**	**-**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Ind. & Com.	MM CFD	-	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.9	0.9
Residential	MM CFD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CFD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**MM CFD**	**-**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**0.9**	**0.9**
Ind. & Com.	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Residential	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**MM CMD**	**-**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Ind. & Com.	M CMD	-	5.6	8.4	11.2	14.0	16.8	19.5	22.3	25.1	25.2	25.2
Residential	M CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	M CMD	-	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.4
Total	**M CMD**	**-**	**5.6**	**8.5**	**11.3**	**14.1**	**17.0**	**19.8**	**22.6**	**25.5**	**25.5**	**25.6**

Volumes: Baghlan												
Sector	**Unit**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Ind. & Com.	MM CF	-	385.0	589.5	801.3	1,020.7	1,247.8	1,482.9	1,726.1	1,977.8	2,015.5	2,054.0
Residential	MM CF	-	3.2	3.8	4.6	5.5	6.6	7.9	9.5	11.4	13.6	16.4
CNG	MM CF	-	8.1	16.6	25.5	34.9	44.7	54.9	65.7	76.9	88.7	101.0
Total	**MM CF**	**-**	**396.3**	**609.9**	**831.4**	**1,061.0**	**1,299.0**	**1,545.7**	**1,801.3**	**2,066.1**	**2,117.9**	**2,171.4**
Ind. & Com.	MM CM	-	10.9	16.7	22.7	28.9	35.3	41.9	48.8	55.9	57.0	58.1
Residential	MM CM	-	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5
CNG	MM CM	-	0.2	0.5	0.7	1.0	1.3	1.6	1.9	2.2	2.5	2.9
Total	**MM CM**	**-**	**11.2**	**17.2**	**23.5**	**30.0**	**36.7**	**43.7**	**50.9**	**58.4**	**59.9**	**61.4**
Ind. & Com.	M CM	-	10,884.7	16,664.2	22,651.5	28,852.4	35,272.7	41,918.2	48,795.2	55,909.9	56,976.6	58,063.5
Residential	M CM	-	90.1	108.1	129.6	155.4	186.4	223.6	268.2	321.6	385.8	462.7
CNG	M CM	-	228.9	468.9	721.7	985.6	1,262.2	1,552.8	1,857.5	2,174.8	2,507.5	2,855.7
Total	**M CM**	**-**	**11,203.7**	**17,241.2**	**23,502.8**	**29,993.5**	**36,721.3**	**43,694.7**	**50,920.9**	**58,406.3**	**59,869.9**	**61,381.9**
Ind. & Com.	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Residential	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**BCM**	**-**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**
Ind. & Com.	MM CFD	-	1.1	1.6	2.2	2.8	3.4	4.1	4.7	5.4	5.5	5.6
Residential	MM CFD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CFD	-	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3
Total	**MM CFD**	**-**	**1.1**	**1.7**	**2.3**	**2.9**	**3.6**	**4.2**	**4.9**	**5.7**	**5.8**	**5.9**
Ind. & Com.	MM CMD	-	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
Residential	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**MM CMD**	**-**	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.2**	**0.2**	**0.2**
Ind. & Com.	M CMD	-	29.8	45.7	62.1	79.0	96.6	114.8	133.7	153.2	156.1	159.1
Residential	M CMD	-	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.9	1.1	1.3
CNG	M CMD	-	0.6	1.3	2.0	2.7	3.5	4.3	5.1	6.0	6.9	7.8
Total	**M CMD**	**-**	**30.7**	**47.2**	**64.4**	**82.2**	**100.6**	**119.7**	**139.5**	**160.0**	**164.0**	**168.2**

Volumes: Kunduz												
Sector	**Unit**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Ind. & Com.	MM CF	-	505.8	777.1	1,060.2	1,355.4	1,663.0	1,983.5	2,317.2	2,664.8	2,725.5	2,787.6
Residential	MM CF	-	3.2	3.9	4.8	5.9	7.3	9.0	11.1	13.7	16.9	20.8
CNG	MM CF	-	11.5	23.5	36.0	49.1	62.7	76.9	91.6	107.0	123.1	139.8
Total	**MM CF**	**-**	**520.4**	**804.6**	**1,101.0**	**1,410.4**	**1,733.0**	**2,069.4**	**2,420.0**	**2,785.5**	**2,865.4**	**2,948.1**
Ind. & Com.	MM CM	-	14.3	22.0	30.0	38.3	47.0	56.1	65.5	75.3	77.0	78.8
Residential	MM CM	-	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.6
CNG	MM CM	-	0.3	0.7	1.0	1.4	1.8	2.2	2.6	3.0	3.5	4.0
Total	**MM CM**	**-**	**14.7**	**22.7**	**31.1**	**39.9**	**49.0**	**58.5**	**68.4**	**78.7**	**81.0**	**83.3**
Ind. & Com.	M CM	-	14,297.6	21,968.8	29,970.6	38,313.8	47,009.6	56,069.5	65,505.3	75,329.1	77,045.1	78,800.3
Residential	M CM	-	89.8	110.6	136.3	167.9	206.9	254.9	314.0	386.9	476.7	587.3
CNG	M CM	-	324.3	664.1	1,017.9	1,387.2	1,771.8	2,173.4	2,590.4	3,025.6	3,479.1	3,950.9
Total	**M CM**	**-**	**14,711.7**	**22,743.5**	**31,124.8**	**39,868.9**	**48,988.3**	**58,497.8**	**68,409.7**	**78,741.6**	**81,000.9**	**83,338.4**
Ind. & Com.	BCM	-	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Residential	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**BCM**	**-**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**
Ind. & Com.	MM CFD	-	1.4	2.1	2.9	3.7	4.6	5.4	6.3	7.3	7.5	7.6
Residential	MM CFD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
CNG	MM CFD	-	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.4
Total	**MM CFD**	**-**	**1.4**	**2.2**	**3.0**	**3.9**	**4.7**	**5.7**	**6.6**	**7.6**	**7.9**	**8.1**
Ind. & Com.	MM CMD	-	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
Residential	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**MM CMD**	**-**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**
Ind. & Com.	M CMD	-	39.2	60.2	82.1	105.0	128.8	153.6	179.5	206.4	211.1	215.9
Residential	M CMD	-	0.2	0.3	0.4	0.5	0.6	0.7	0.9	1.1	1.3	1.6
CNG	M CMD	-	0.9	1.8	2.8	3.8	4.9	6.0	7.1	8.3	9.5	10.8
Total	**M CMD**	**-**	**40.3**	**62.3**	**85.3**	**109.2**	**134.2**	**160.3**	**187.4**	**215.7**	**221.9**	**228.3**

Volumes: Parwan (Charikar)												
Sector	**Unit**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Ind. & Com.	MM CF	-	143.5	215.8	288.1	360.4	432.6	504.9	577.2	649.4	649.9	650.4
Residential	MM CF	-	2.4	2.2	2.0	1.8	1.6	1.5	1.4	1.2	1.1	1.0
CNG	MM CF	-	0.9	1.8	2.8	3.7	4.7	5.6	6.5	7.4	8.3	9.3
Total	**MM CF**	**-**	**146.9**	**219.8**	**292.9**	**365.9**	**438.9**	**512.0**	**585.0**	**658.1**	**659.4**	**660.7**
Ind. & Com.	MM CM	-	4.1	6.1	8.1	10.2	12.2	14.3	16.3	18.4	18.4	18.4
Residential	MM CM	-	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CM	-	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3
Total	**MM CM**	**-**	**4.2**	**6.2**	**8.3**	**10.3**	**12.4**	**14.5**	**16.5**	**18.6**	**18.6**	**18.7**
Ind. & Com.	M CM	-	4,057.9	6,100.8	8,143.8	10,186.8	12,229.8	14,272.7	16,315.7	18,358.7	18,372.7	18,386.7
Residential	M CM	-	67.8	61.7	56.1	51.1	46.5	42.3	38.5	35.0	31.9	29.0
CNG	M CM	-	26.7	51.9	78.6	105.3	132.0	157.2	183.9	210.6	235.9	262.5
Total	**M CM**	**-**	**4,152.3**	**6,214.5**	**8,278.6**	**10,343.2**	**12,408.2**	**14,472.3**	**16,538.1**	**18,604.3**	**18,640.4**	**18,678.3**
Ind. & Com.	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Residential	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**BCM**	**-**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Ind. & Com.	MM CFD	-	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	1.8	1.8
Residential	MM CFD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CFD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**MM CFD**	**-**	**0.4**	**0.6**	**0.8**	**1.0**	**1.2**	**1.4**	**1.6**	**1.8**	**1.8**	**1.8**
Ind. & Com.	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Residential	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**MM CMD**	**-**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**
Ind. & Com.	M CMD	-	11.1	16.7	22.3	27.9	33.5	39.1	44.7	50.3	50.3	50.4
Residential	M CMD	-	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
CNG	M CMD	-	0.1	0.1	0.2	0.3	0.4	0.4	0.5	0.6	0.6	0.7
Total	**M CMD**	**-**	**11.4**	**17.0**	**22.7**	**28.3**	**34.0**	**39.7**	**45.3**	**51.0**	**51.1**	**51.2**

Volumes: Kabul												
Sector	**Unit**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Ind. & Com.	MM CF	-	8,696.2	13,471.9	18,529.8	23,882.9	29,544.2	35,527.8	41,847.8	48,519.2	50,032.4	51,592.7
Residential	MM CF	-	6.2	10.2	16.7	27.4	44.8	73.3	119.9	196.1	320.9	525.0
CNG	MM CF	-	256.0	527.6	815.4	1,120.3	1,442.9	1,784.2	2,144.8	2,525.7	2,927.8	3,352.0
Total	**MM CF**	**-**	**8,958.5**	**14,009.6**	**19,362.0**	**25,030.5**	**31,031.9**	**37,385.2**	**44,112.4**	**51,241.0**	**53,281.0**	**55,469.7**
Ind. & Com.	MM CM	-	245.8	380.8	523.8	675.1	835.2	1,004.3	1,183.0	1,371.6	1,414.3	1,458.5
Residential	MM CM	-	0.2	0.3	0.5	0.8	1.3	2.1	3.4	5.5	9.1	14.8
CNG	MM CM	-	7.2	14.9	23.1	31.7	40.8	50.4	60.6	71.4	82.8	94.8
Total	**MM CM**	**-**	**253.2**	**396.0**	**547.3**	**707.6**	**877.2**	**1,056.8**	**1,247.0**	**1,448.5**	**1,506.2**	**1,568.0**
Ind. & Com.	M CM	-	245,829.7	380,830.1	523,811.4	675,134.0	835,172.9	1,004,318.3	1,182,975.9	1,371,567.7	1,414,343.3	1,458,452.2
Residential	M CM	-	176.6	289.0	472.9	773.6	1,265.8	2,071.0	3,388.3	5,543.7	9,070.2	14,840.0
CNG	M CM	-	7,237.6	14,913.3	23,050.9	31,668.6	40,789.0	50,435.9	60,630.3	71,397.6	82,764.4	94,756.0
Total	**M CM**	**-**	**253,244.0**	**396,032.4**	**547,335.1**	**707,576.3**	**877,227.7**	**1,056,825.1**	**1,246,994.5**	**1,448,509.0**	**1,506,177.9**	**1,568,048.1**
Ind. & Com.	BCM	-	0.2	0.4	0.5	0.7	0.8	1.0	1.2	1.4	1.4	1.5
Residential	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	BCM	-	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Total	**BCM**	**-**	**0.3**	**0.4**	**0.5**	**0.7**	**0.9**	**1.1**	**1.2**	**1.4**	**1.5**	**1.6**
Ind. & Com.	MM CFD	-	23.8	36.9	50.8	65.4	80.9	97.3	114.7	132.9	137.1	141.3
Residential	MM CFD	-	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.5	0.9	1.4
CNG	MM CFD	-	0.7	1.4	2.2	3.1	4.0	4.9	5.9	6.9	8.0	9.2
Total	**MM CFD**	**-**	**24.5**	**38.4**	**53.0**	**68.6**	**85.0**	**102.4**	**120.9**	**140.4**	**146.0**	**152.0**
Ind. & Com.	MM CMD	-	0.7	1.0	1.4	1.8	2.3	2.8	3.2	3.8	3.9	4.0
Residential	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CMD	-	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3
Total	**MM CMD**	**-**	**0.7**	**1.1**	**1.5**	**1.9**	**2.4**	**2.9**	**3.4**	**4.0**	**4.1**	**4.3**
Ind. & Com.	M CMD	-	673.5	1,043.4	1,435.1	1,849.7	2,288.1	2,751.6	3,241.0	3,757.7	3,874.9	3,995.8
Residential	M CMD	-	0.5	0.8	1.3	2.1	3.5	5.7	9.3	15.2	24.8	40.7
CNG	M CMD	-	19.8	40.9	63.2	86.8	111.8	138.2	166.1	195.6	226.8	259.6
Total	**M CMD**	**-**	**693.8**	**1,085.0**	**1,499.5**	**1,938.6**	**2,403.4**	**2,895.4**	**3,416.4**	**3,968.5**	**4,126.5**	**4,296.0**

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Annex 2: Estimation of CNG Demand for the Future

Concept	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Balk												
Vehicles Gasoline	#	36,937	37,800	38,683	39,587	40,512	41,458	42,427	43,418	44,432	45,470	46,532
Market	%	0%	2%	4%	6%	8%	10%	12%	14%	16%	18%	20%
Vehicles CNG	#	-	756	1,547	2,375	3,241	4,146	5,091	6,079	7,109	8,185	9,306
NG Consumption	MM CF	-	38	77	118	161	206	253	302	353	407	462
Jawzjan												
Vehicles Gasoline	#	2,032	2,079	2,128	2,178	2,229	2,281	2,334	2,389	2,445	2,502	2,560
Market	%	0%	2%	4%	6%	8%	10%	12%	14%	16%	18%	20%
Vehicles CNG	#	-	42	85	131	178	228	280	334	391	450	512
NG Consumption	MM CF	-	2	4	7	9	11	14	17	19	22	25
Samangan												
Vehicles Gasoline	#	388	388	388	388	388	388	388	388	388	388	388
Market	%	0%	2%	4%	6%	8%	10%	12%	14%	16%	18%	20%
Vehicles CNG	#	-	8	16	23	31	39	47	54	62	70	78
NG Consumption	MM CF	-	0	1	1	2	2	2	3	3	3	4
Baghlan												
Vehicles Gasoline	#	7,802	7,944	8,089	8,237	8,387	8,540	8,696	8,855	9,017	9,182	9,350
Market	%	0%	2%	4%	6%	8%	10%	12%	14%	16%	18%	20%
Vehicles CNG	#	-	159	324	494	671	854	1,044	1,240	1,443	1,653	1,870
NG Consumption	MM CF	-	8	16	25	33	42	52	62	72	82	93
Kunduz												
Vehicles Gasoline	#	11,318	11,567	11,822	12,082	12,348	12,620	12,898	13,182	13,472	13,769	14,072
Market	%	0%	2%	4%	6%	8%	10%	12%	14%	16%	18%	20%
Vehicles CNG	#	-	231	473	725	988	1,262	1,548	1,845	2,156	2,478	2,814
NG Consumption	MM CF	-	11	23	36	49	63	77	92	107	123	140
Parwan												
Vehicles Gasoline	#	935	935	935	935	935	935	935	935	935	935	935
Market	%	0%	2%	4%	6%	8%	10%	12%	14%	16%	18%	20%
Vehicles CNG	#	-	19	37	56	75	94	112	131	150	168	187
NG Consumption	MM CF	-	1	2	3	4	5	6	7	7	8	9
Kabul												
Vehicles Gasoline	#	250,094	257,687	265,511	273,572	281,878	290,436	299,254	308,340	317,702	327,348	337,287
Market	%	0%	2%	4%	6%	8%	10%	12%	14%	16%	18%	20%
Vehicles CNG	#	-	5,154	10,620	16,414	22,550	29,044	35,910	43,168	50,832	58,923	67,457
NG Consumption	MM CF	-	256	527	815	1,120	1,443	1,784	2,144	2,525	2,926	3,350

Annex 3: Provinces and Districts Covered by the NRVA Survey

Province Code	Province Name	District Name	District Code	Province Code	Province Name	District Name	District Code	Province Code	Province Name	District Name	District Code	Province Code	Province Name	District Name	District Code
1	Kabul	Provincial Center Of Kabul (Kabul)	101	6	Ghazni	Zanakhan	603	9	Khost	Sabari (Yaqubi)	905	12	Laghman	Dawlat Shah	1205
1	Kabul	Dehsabz	102	6	Ghazni	Khwaja Omari	604	9	Khost	Musa Khel	906	13	Nooristan	Provincial Center Of Nooristan (Paroon)	1301
1	Kabul	Mir Bacha Kot	103	6	Ghazni	Rashidan	605	9	Khost	Qalandar	907	13	Nooristan	Noor Gram	1302
1	Kabul	Kalakan	104	6	Ghazni	Wali Mohammad Shahid Khugyani	606	9	Khost	Nadirshah Kot	908	13	Nooristan	Duab	1303
1	Kabul	Qara Bagh	105	6	Ghazni	Jaghatu	607	9	Khost	Manduzay (Esmayel Khel)	909	13	Nooristan	Waygal	1304
1	Kabul	Farza	106	6	Ghazni	Waghaz	608	9	Khost	Shamul	910	13	Nooristan	Wama	1305
1	Kabul	Estalef	107	6	Ghazni	Qara Bagh	609	9	Khost	Spera	911	13	Nooristan	Mandol	1306
1	Kabul	Guldara	108	6	Ghazni	Giro	610	9	Khost	Tanay	912	13	Nooristan	Kamdesh	1307
1	Kabul	Shakar Dara	109	6	Ghazni	Andar	611	9	Khost	Gurbuz	913	13	Nooristan	Bargi Matal	1308
1	Kabul	Paghman	110	6	Ghazni	Nawur	612	10	Nangarhar	Provincial Center Of Nangarhar (Jalalabad)	1001	14	Badakhshan	Provincial Center Of Badakhshan (Faiz Abad)	1401
1	Kabul	Chahar Asyab	111	6	Ghazni	Ajristan	613	10	Nangarhar	Behsud	1002	14	Badakhshan	Yaftal -I-Sufla	1402
1	Kabul	Musahi	112	6	Ghazni	Malistan	614	10	Nangarhar	Surkh Rud	1003	14	Badakhshan	Argo	1403
1	Kabul	Khak-I-Jabar	113	6	Ghazni	Jaghuri	615	10	Nangarhar	Chaparhar	1004	14	Badakhshan	Darayim	1404
1	Kabul	Bagrami	114	6	Ghazni	Muqur	616	10	Nangarhar	Rodat	1005	14	Badakhshan	Khash	1405
1	Kabul	Surubi	115	6	Ghazni	Ab Band	617	10	Nangarhar	Kama	1006	14	Badakhshan	Jurm	1406
2	Kapisa	Provincial Center of Kapisa (Mahmood Raqi)	201	6	Ghazni	Gelan	618	10	Nangarhar	Kuzkunar	1007	14	Badakhshan	Wardooj	1407
2	Kapisa	Hissa-I-Duwumi Kohistan	202	6	Ghazni	Nawa	619	10	Nangarhar	Darah-I-Noor	1008	14	Badakhshan	Baharak	1408
2	Kapisa	Hissa-I-Awal Kohistan	203	7	Paktika	Provincial Center of Paktika (Sharan)	701	10	Nangarhar	Sher Zad	1009	14	Badakhshan	Shuhada	1409
2	Kapisa	Nijrab	204	7	Paktika	Mata Khan	702	10	Nangarhar	Hesarak	1010	14	Badakhshan	Kohistan	1410
2	Kapisa	Koh Band	205	7	Paktika	Yosuf Khel	703	10	Nangarhar	Khugyani	1011	14	Badakhshan	Yawan	1411
2	Kapisa	Tagab	206	7	Paktika	Yahya Khel	704	10	Nangarhar	Pachir Wagam	1012	14	Badakhshan	Shahri Buzurg	1412
2	Kapisa	Alasai	207	7	Paktika	Omna	705	10	Nangarhar	Deh Bala	1013	14	Badakhshan	Kishm	1413
3	Parwan	Provincial Center of Parwan (Charikar)	301	7	Paktika	Sar Rawza	706	10	Nangarhar	Kot	1014	14	Badakhshan	Tagab	1414
3	Parwan	Sayyid Khel	302	7	Paktika	Zarghun Shahr	707	10	Nangarhar	Achin	1015	14	Badakhshan	Tashkan	1415
3	Parwan	Jabulussaraj	303	7	Paktika	Jani Khel	708	10	Nangarhar	Nazyan	1016	14	Badakhshan	Kiran Wa Menjan	1416
3	Parwan	Salang	304	7	Paktika	Gomal	709	10	Nangarhar	Dur Baba	1017	14	Badakhshan	Eshkashim	1418
3	Parwan	Shinwari	305	7	Paktika	Surubi	710	10	Nangarhar	Shinwar	1018	14	Badakhshan	Wakhan	1419
3	Parwan	Syahgird (Ghorband)	306	7	Paktika	Urgoon	711	10	Nangarhar	Bati Kot	1019	14	Badakhshan	Shighnan	1420
3	Parwan	Bagram	307	7	Paktika	Ziruk	712	10	Nangarhar	Muhmand Dara	1020	14	Badakhshan	Arghanj Khwah	1421
3	Parwan	Koh-I-Safi	308	7	Paktika	Nika	713	10	Nangarhar	Goshta	1021	14	Badakhshan	Raghistan	1422
3	Parwan	Shaykh Ali	309	7	Paktika	Dila Wa Khushamand	714	10	Nangarhar	Lalpoor	1022	14	Badakhshan	Khwahan	1423
3	Parwan	Surkhi Parsa	310	7	Paktika	Wazakhwah	715	11	Kunarha	Provincial Center of Kunarha (Asad Abad)	1101	14	Badakhshan	Kufab	1424
4	Wardak	Provincial Center Of Wardak (Maidan Shahr)	401	7	Paktika	Turwo	716	11	Kunarha	Watapoor	1102	14	Badakhshan	Yamgan	1425
4	Wardak	Jalrez	402	7	Paktika	Wor Mamay	717	11	Kunarha	Dara-I-Pech	1103	14	Badakhshan	Darwaz-I- Bala (Nesay)	1426
4	Wardak	Hissa-I- Awal Behsud	403	7	Paktika	Barmal	718	11	Kunarha	Narang Wa Badil	1104	14	Badakhshan	Darwaz-I- Payin (Mamay)	1427
4	Wardak	Markaz-I-Behsud	404	7	Paktika	Giyan	719	11	Kunarha	Sar Kani	1105	14	Badakhshan	Shiki	1428
4	Wardak	Daimirdad	405	8	Paktya	Provincial Center of Paktya (Gardez)	801	11	Kunarha	Mara Wara	1106	15	Takhar	Provincial Center Of Takhar (Taluqan)	1501
4	Wardak	Jaghatu	406	8	Paktya	Sayyid Karam	802	11	Kunarha	Dangam	1107	15	Takhar	Hazar Sumuch	1502
4	Wardak	Chak-I-Wardak	407	8	Paktya	Zurmat	803	11	Kunarha	Bar Kunar	1108	15	Takhar	Baharak	1503
4	Wardak	Sayyidabad	408	8	Paktya	Wuza Jadran	805	11	Kunarha	Shigal Wa Sheltan	1109	15	Takhar	Khwaja Ghar	1504
4	Wardak	Nerkh	409	8	Paktya	Laja Ahmad Khel	806	11	Kunarha	Chapa Dara	1110	15	Takhar	Bangi	1505
5	Logar	Provincial Center of Logar (Puli Alam)	501	8	Paktya	Jani Khel	807	11	Kunarha	Noorgal	1111	15	Takhar	Eshkamesh	1506
5	Logar	Baraki Barak	502	8	Paktya	Dand Patan	808	11	Kunarha	Sawkai	1112	15	Takhar	Chal	1507
5	Logar	Charkh	503	8	Paktya	Samkani	809	11	Kunarha	Khas Kunar	1113	15	Takhar	Namak Ab	1508
5	Logar	Khushi	504	8	Paktya	Jaji	810	11	Kunarha	Nari	1114	15	Takhar	Farkhar	1509
5	Logar	Mohammad Agha	505	8	Paktya	Ahmadaba	811	11	Kunarha	Ghazi Abad	1115	15	Takhar	Kalafgan	1510
5	Logar	Khar War	506	9	Khost	Provincial Center of Khost (Khost)	901	12	Laghman	Provincial Center Of Laghman (Mehterlam)	1201	15	Takhar	Rustaq	1511
5	Logar	Azra	507	9	Khost	Ali Sher	902	12	Laghman	Qarghayee	1202	15	Takhar	Chahab	1512
6	Ghazni	Provincial Center of Ghazni (Ghazni)	601	9	Khost	Baak	903	12	Laghman	Alingar	1203	15	Takhar	Yangi Qala	1513
6	Ghazni	Deh Yak	602	9	Khost	Jaji Maidan	904	12	Laghman	Alishing	1204	15	Takhar	Khwaja Bahawuddin	1514

Province Code	Province Name	District Name	District Code
15	Takhar	Darqad	1515
15	Takhar	Dashti Qala	1516
15	Takhar	Warsaj	1517
16	Baghlan	Provincial Center Of Baghlan (Pul-I-Khumri)	1601
16	Baghlan	Baghlan-I-Jadeed	1602
16	Baghlan	Dahana-I-Ghuri	1603
16	Baghlan	Dushi	1604
16	Baghlan	Khinjan	1605
16	Baghlan	Andarab	1606
16	Baghlan	Nahreen	1607
16	Baghlan	Burka	1608
16	Baghlan	Tala Wa Barfak	1609
16	Baghlan	Pul-I-Hisar	1610
16	Baghlan	Deh Salah	1611
16	Baghlan	Jalga	1612
16	Baghlan	Khost Wa Firing	1613
16	Baghlan	Firing Wa Gharu	1614
16	Baghlan	Gozargah-I-Noor	1615
17	Kunduz	Provincial Center Of Kunduz (Kunduz)	1701
17	Kunduz	Hazrati Imam Sahib	1702
17	Kunduz	Qala-I-Zal	1703
17	Kunduz	Char Darah	1704
17	Kunduz	Ali Abad	1705
17	Kunduz	Khan Abad	1706
17	Kunduz	Dasht-I-Archi	1707
18	Samangan	Provincial Center Of Samangan (Aybak)	1801
18	Samangan	Hazrat-I-Sultan	1802
18	Samangan	Feroz Nakhcheer	1803
18	Samangan	Dara-I-Soof-I-Bala	1804
18	Samangan	Dara-I-Soof-I-Payin	1805
18	Samangan	Roi-Do-Ab	1806
18	Samangan	Khuram Wa Sarbagh	1807
19	Balkh	Provincial Center Of Balkh (Mazar-I-Sharif)	1901
19	Balkh	Dehdadi	1902
19	Balkh	Nahri Shahi	1903
19	Balkh	Marmul	1904
19	Balkh	Khulm	1905
19	Balkh	Kaldar	1906
19	Balkh	Shortepa	1907
19	Balkh	Dawlat Abad	1908
19	Balkh	Balkh	1909
19	Balkh	Char Bolak	1910
19	Balkh	Chimtal	1911
19	Balkh	Sholgara	1912
19	Balkh	Char Kent	1913
19	Balkh	Kishindeh	1914
19	Balkh	Zari	1915
20	Jawzjan	Provincial Center Of Jawzjan (Sheberghan)	2001
20	Jawzjan	Aqchah	2002
20	Jawzjan	Faizabad	2003
20	Jawzjan	Mardyan	2004
20	Jawzjan	Mingajik	2005
20	Jawzjan	Qarqin	2006
20	Jawzjan	Khamyab	2007
20	Jawzjan	Qush Tepa	2008
20	Jawzjan	Darzab	2009
20	Jawzjan	Khwaja Dukoh	2010
20	Jawzjan	Khanaqa	2011
21	Sar-I- Pul	Provincial Center Of Sar-I-Pul (Sar-I-Pul)	2101
21	Sar-I- Pul	Sozma Qala	2102
21	Sar-I- Pul	Sayyad	2103
21	Sar-I- Pul	Kohistanat	2104
21	Sar-I- Pul	Balkhab	2105
21	Sar-I- Pul	Sangcharak	2106
21	Sar-I- Pul	Gosfandi	2107
22	Faryab	MARKAZI FARYAB - MAYMANA	2201
22	Faryab	Pashtun Kot	2202
22	Faryab	Khwaja Sabz Poshi Wali	2203
22	Faryab	Almar	2204
22	Faryab	Qaisar	2205
22	Faryab	Kohistan	2206
22	Faryab	Gurziwan	2207
22	Faryab	Bilchiragh	2208
22	Faryab	Shirin Tagab	2209
22	Faryab	DAWLAT ABAD	2210
22	Faryab	Qaram Qul	2211
22	Faryab	Khani Charbagh	2212
22	Faryab	ANDKHOY	2213
22	Faryab	Qurghan	2214
23	Badghis	Provincial Center Of Badghis (Qala-I-Now)	2301
23	Badghis	Muqur	2302
23	Badghis	Ab Kamari	2303
23	Badghis	Qadis	2304
23	Badghis	Jawand	2305
23	Badghis	Ghormach	2306
23	Badghis	Bala Murghab	2307
24	Herat	Provincial Center Of Herat (Herat)	2401
24	Herat	Enjil	2402
24	Herat	Nizam-I-Shahid (Guzara)	2403
24	Herat	Pashtun Zarghun	2404
24	Herat	Karrukh	2405
24	Herat	Kushk (Rubat-I-Sangi)	2406
24	Herat	Gulran	2407
24	Herat	Kohsan	2408
24	Herat	Ghoryan	2409
24	Herat	Zendajan	2410
24	Herat	Adraskan	2411
24	Herat	Shindand	2412
24	Herat	Fersi	2413
24	Herat	Obe	2414
24	Herat	Chishti Sharif	2415
24	Herat	Kushk-I-Kuhna	2416
25	Farah	Provincial Center Of Farah (Farah)	2501
25	Farah	Pushtrud	2502
25	Farah	Khak-I-Safed	2503
25	Farah	Anar Dara	2504
25	Farah	Qala-I-Kah	2505
25	Farah	Shibkoh	2506
25	Farah	Lash-I-Juwayn	2507
25	Farah	Bakwa	2508
25	Farah	Bala Buluk	2509
25	Farah	Gulistan	2510
25	Farah	Pur Chaman	2511
26	Nimroz	Provincial Center Of Nimroz (Zaranj)	2601
26	Nimroz	Kang	2602
26	Nimroz	Char Burjak	2603
26	Nimroz	Asl-I-Chakhansur	2604
26	Nimroz	Khashrod	2605
27	Helmand	Provincial Center Of Helmand (Lashkargah)	2701
27	Helmand	Nahr-I-Saraj	2702
27	Helmand	Nad Ali	2703
27	Helmand	Nawa-I- Barikzayi	2704
27	Helmand	Garm Ser	2705
27	Helmand	Sangin Qala	2706
27	Helmand	Kajaki	2707
27	Helmand	Baghran	2708
27	Helmand	Musa Qala	2709
27	Helmand	Nawzad	2710
27	Helmand	Washer	2711
27	Helmand	Reg-I- Khan Nishin	2712
27	Helmand	Dishu	2713
28	Kandahar	Provincial Center Of Kandahar (Kandahar)	2801
28	Kandahar	Daman	2802
28	Kandahar	Shah Wali Kott	2803
28	Kandahar	Arghandab	2804
28	Kandahar	Khakrez	2805
28	Kandahar	Ghorak	2806
28	Kandahar	Maiwand	2807
28	Kandahar	Zhire	2808
28	Kandahar	Panjwayee	2809
28	Kandahar	Shorabak	2811
28	Kandahar	Spin Boldak	2812
28	Kandahar	Arghistan	2813
28	Kandahar	Maruf	2814
28	Kandahar	Miyanishin	2815
28	Kandahar	Nesh	2816
29	Zabul	Provincial Center Of Zabul (Qalat)	2901
29	Zabul	Shah Joi	2902
29	Zabul	Arghandab	2903
29	Zabul	Kakar	2904
29	Zabul	Day Chopan	2905
29	Zabul	Mizan	2906
29	Zabul	Tarank Wa Jaldak	2907
29	Zabul	Shinkai	2908
29	Zabul	Atghar	2909
29	Zabul	Shemel Zayi	2910
29	Zabul	Naw Bahar	2911
30	Urozgan	Provincial Center Of Urozgan (Tirinkot)	3001
30	Urozgan	Chora	3002
30	Urozgan	Khas Urozgan	3003
30	Urozgan	Shahidhassas	3004
30	Urozgan	Dehraoud	3005
31	Ghor	Provincial Center of Ghor (Chighcheran)	3101
31	Ghor	Dawlatyar	3102
31	Ghor	Char Sada	3103
31	Ghor	Shahrak	3104
31	Ghor	Duleena	3105
31	Ghor	Pasaband	3106
31	Ghor	Lal Wa Sarjangal	3107
31	Ghor	Tulak	3108
31	Ghor	Saghar	3109
31	Ghor	Taywara	3110
32	Bamyan	Provincial Center of Bamyan (Bamyan)	3201
32	Bamyan	Shebar	3202
32	Bamyan	Saighan	3203
32	Bamyan	Kahmard	3204
32	Bamyan	Yakawlang	3205
32	Bamyan	Panjab	3206
32	Bamyan	Waras	3207
33	Panjsher	Provincial Center of Panjsher (Bazarak)	3301
33	Panjsher	Rukha	3302
33	Panjsher	Unaba	3303
33	Panjsher	Darah	3304
33	Panjsher	Hissa-I-Awal (Khinj)	3305
33	Panjsher	Shutul	3306
33	Panjsher	Paryan	3307
34	Daykundi	Provincial Center Of Daykundi (Nili)	3401
34	Daykundi	Shahristan	3402
34	Daykundi	Miramor	3403
34	Daykundi	Ishterlai	3404
34	Daykundi	Sang-I-Takht	3405
34	Daykundi	Khedir	3406
34	Daykundi	Kejran	3407
34	Daykundi	Geti	3408
34	Daykundi	Gizab	3409

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Annex 4: Questions Used of the NRVA

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2.26 Which main toilet facility does your household use?

1 None (open field, bush) or Sahrahi >>**2.30**
2 Dearan (area inside or outside compound but not pit)>>**2.30**
3 Open pit
4 Traditional covered latrine
5 Improved latrine
6 Flush latrine
7 Other (specify_____)

1 2 3 4 5 6 7
☐ ○○○○○○○

2.25 How much did this household spend in the last month for each type of fuel used in the household? (Afghanis) If did not spend anything put "0)

☐☐☐☐	ELECTRICITY
☐☐☐☐	GAS
☐☐☐☐	FUEL OIL
☐☐☐☐	FIREWOOD
☐☐☐☐	CHARCOAL
☐☐☐☐	COAL
☐☐☐☐	STRAW, PING, MANURE

2.22 In the past 30 days, what has been the household's main source of lighting?

1 None ☐
2 Oil lamp 1 ○
3 Candles 2 ○
4 Electricity from grid 3 ○
5 Generator 4 ○
6 Battery 5 ○
7 Gas 6 ○
8 Firewood 7 ○
9 Other (specify_____) 8 ○ 9 ○

2.23 In the past 30 days, what has been the household's main source of cooking fuel?

○ 1 ○ 5 ○ 9
○ 2 ○ 6 ○ 10
○ 3 ○ 7
○ 4 ○ 8

1 Animal dung
2 Bushes (ping)/ twigs, branches
3 Crop residues
4 Firewood
5 Charcoal/ coal
6 Kerosene or oil
7 Gas
8 Electricity
9 Scavenged material/ trash
10 Other (specify_____)

2.27 Is your toilet facility located within the compound of your household? ☐

1 Yes 1 ○
2 No>>2.29 2 ○

2.28 Is the toilet facility shared with other households? ☐

1 Yes 1 ○
2 No 2 ○

2.29 Is your dwelling connected to a sewage system? ☐

1 Yes 1 ○
2 No 2 ○

2.24 What is the main source of heating for this house in winter?

○ 1 ○ 5 ○ 9
○ 2 ○ 6 ○ 10
○ 3 ○ 7 ○ 11
○ 4 ○ 8

1 No heating in house
2 Electricity
3 Gas
4 Kerosene/ diesel /petrol
5 Firewood
6 Charcoal
7 Coal
8 Straw, bushes/twigs , manure
9 Scavenged materials/ trash
10 Clean
11 Other (specify_____)

.

Annex 5: MATLAB Code to Manage the Data from the NRVA Survey

```
%
%
% This program was created to analyze the household survey for the
% Sheberghan Gas to Power Project in Kabul
clear
warning off;
clc

%Survey Data
fprintf('Reading data')
Step=1

Data=xlsread('Survey.Data.xlsx');
[obs var] = size(Data);
[n col] = size(Data);

% Household weight
fprintf('Applying Household weight')
Step=2

fe    = Data(:,13); %Factor de expansion
k=0;
sfe = sum(fe);

Data_1=ones(sfe,col);

for q = 1:n;
   for h=1:fe(q);
      Data_1(k+h,:)=Data(q,:);
   end;
   k=h+k;
end;

Data=Data_1;

% Stats for all the country
fprintf('Stats for all the country')
Step=3

SpendMatrix=[nanmean(Data(:,4:10));
   nanstd(Data(:,4:10));
   nanmax(Data(:,4:10));
   nanmin(Data(:,4:10))];

LPGStats=[nanmean(Data(:,12));
   nanstd(Data(:,12));
   nanmax(Data(:,12));
   nanmin(Data(:,12))];
```

```
EnergyUse=histc(Data(:,16:18), unique(Data(:,16:18)))./sfe;

T1=SpendMatrix; %This table shows the spend matrix in each energy
T2=LPGStats; %This table shows the LPG stats
T3=EnergyUse; %This table shows the % of each energetic for cooking, heating and lighting

% Stats for Urban
fprintf('Stats for urban')
Step=4

DataUrb=Data(Data(:,3)==1,:);
[nUrb colUrb] = size(DataUrb);

SpendMatrixUrb=[nanmean(DataUrb(:,4:10));
   nanstd(DataUrb(:,4:10));
   nanmax(DataUrb(:,4:10));
   nanmin(DataUrb(:,4:10))];

LPGStatsUrb=[nanmean(DataUrb(:,12));
   nanstd(DataUrb(:,12));
   nanmax(DataUrb(:,12));
   nanmin(DataUrb(:,12))];

EnergyUseUrb=histc(DataUrb(:,16:18), unique(DataUrb(:,16:18)))./nUrb;

T1Urb=SpendMatrixUrb; %This table shows the spend matrix in each energy
T2Urb=LPGStatsUrb; %This table shows the LPG stats
T3Urb=EnergyUseUrb; %This table shows the % of each energetic for cooking, heating and lighting

% Stats for Rural
fprintf('Stats for rural')
Step=5

DataRur=Data(Data(:,3)==2,:);
[nRur colRur] = size(DataRur);

SpendMatrixRur=[nanmean(DataRur(:,4:10));
   nanstd(DataRur(:,4:10));
   nanmax(DataRur(:,4:10));
   nanmin(DataRur(:,4:10))];

LPGStatsRur=[nanmean(DataRur(:,12));
   nanstd(DataRur(:,12));
   nanmax(DataRur(:,12));
   nanmin(DataRur(:,12))];

EnergyUseRur=histc(DataRur(:,16:18), unique(DataRur(:,16:18)))./nRur;

T1Rur=SpendMatrixRur; %This table shows the spend matrix in each energy
T2Rur=LPGStatsRur; %This table shows the LPG stats
```

```
T3Rur=EnergyUseRur; %This table shows the % of each energetic for cooking, heating and lighting

% Stats for provinces
fprintf('Stats for provinces')
Step=6

% Balk (Mazar-e-Sharif) Code 1

Data_1=Data(Data(:,2)==19,:);
[n_1 col_1] = size(Data_1);

SpendMatrix_1=[nanmean(Data_1(:,4:10));
   nanstd(Data_1(:,4:10));
   nanmax(Data_1(:,4:10));
   nanmin(Data_1(:,4:10))];

LPGStats_1=[nanmean(Data_1(:,12));
   nanstd(Data_1(:,12));
   nanmax(Data_1(:,12));
   nanmin(Data_1(:,12))];

EnergyUse_1=histc(Data_1(:,16:18), unique(Data_1(:,16:18)))./n_1;

T1_1=SpendMatrix_1; %This table shows the spend matrix in each energy
T2_1=LPGStats_1; %This table shows the LPG stats
T3_1=EnergyUse_1; %This table shows the % of each energetic for cooking, heating and lighting

Data_1urb=Data_1(Data_1(:,3)==1,:);
[n_1urb col_1urb] = size(Data_1urb);

SpendMatrix_1urb=[nanmean(Data_1urb(:,4:10));
   nanstd(Data_1urb(:,4:10));
   nanmax(Data_1urb(:,4:10));
   nanmin(Data_1urb(:,4:10))];

LPGStats_1urb=[nanmean(Data_1urb(:,12));
   nanstd(Data_1urb(:,12));
   nanmax(Data_1urb(:,12));
   nanmin(Data_1urb(:,12))];

EnergyUse_1urb=histc(Data_1urb(:,16:18), unique(Data_1urb(:,16:18)))./n_1urb;

T1_1urb=SpendMatrix_1urb; %This table shows the spend matrix in each energy
T2_1urb=LPGStats_1urb; %This table shows the LPG stats
T3_1urb=EnergyUse_1urb; %This table shows the % of each energetic for cooking, heating and
lighting

Data_1rur=Data_1(Data_1(:,3)==2,:);
[n_1rur col_1rur] = size(Data_1rur);

SpendMatrix_1rur=[nanmean(Data_1rur(:,4:10));
```

```
    nanstd(Data_1rur(:,4:10));
    nanmax(Data_1rur(:,4:10));
    nanmin(Data_1rur(:,4:10))];

LPGStats_1rur=[nanmean(Data_1rur(:,12));
    nanstd(Data_1rur(:,12));
    nanmax(Data_1rur(:,12));
    nanmin(Data_1rur(:,12))];

EnergyUse_1rur=histc(Data_1rur(:,16:18), unique(Data_1rur(:,16:18)))./n_1rur;

T1_1rur=SpendMatrix_1rur; %This table shows the spend matrix in each energy
T2_1rur=LPGStats_1rur; %This table shows the LPG stats
T3_1rur=EnergyUse_1rur; %This table shows the % of each energetic for cooking, heating and lighting

% Jawzjan (Sheberghan) Code 2

Data_2=Data(Data(:,2)==20,:);
[n_2 col_2] = size(Data_2);

SpendMatrix_2=[nanmean(Data_2(:,4:10));
    nanstd(Data_2(:,4:10));
    nanmax(Data_2(:,4:10));
    nanmin(Data_2(:,4:10))];

LPGStats_2=[nanmean(Data_2(:,12));
    nanstd(Data_2(:,12));
    nanmax(Data_2(:,12));
    nanmin(Data_2(:,12))];

EnergyUse_2=histc(Data_2(:,16:18), unique(Data_2(:,16:18)))./n_2;

T1_2=SpendMatrix_2; %This table shows the spend matrix in each energy
T2_2=LPGStats_2; %This table shows the LPG stats
T3_2=EnergyUse_2; %This table shows the % of each energetic for cooking, heating and lighting

Data_2urb=Data_2(Data_2(:,3)==1,:);
[n_2urb col_2urb] = size(Data_2urb);

SpendMatrix_2urb=[nanmean(Data_2urb(:,4:10));
    nanstd(Data_2urb(:,4:10));
    nanmax(Data_2urb(:,4:10));
    nanmin(Data_2urb(:,4:10))];

LPGStats_2urb=[nanmean(Data_2urb(:,12));
    nanstd(Data_2urb(:,12));
    nanmax(Data_2urb(:,12));
    nanmin(Data_2urb(:,12))];

EnergyUse_2urb=histc(Data_2urb(:,16:18), unique(Data_2urb(:,16:18)))./n_2urb;
```

```
T1_2urb=SpendMatrix_2urb; %This table shows the spend matrix in each energy
T2_2urb=LPGStats_2urb; %This table shows the LPG stats
T3_2urb=EnergyUse_2urb; %This table shows the % of each energetic for cooking, heating and
lighting

Data_2rur=Data_2(Data_2(:,3)==2,:);
[n_2rur col_2rur] = size(Data_2rur);

SpendMatrix_2rur=[nanmean(Data_2rur(:,4:10));
   nanstd(Data_2rur(:,4:10));
   nanmax(Data_2rur(:,4:10));
   nanmin(Data_2rur(:,4:10))];

LPGStats_2rur=[nanmean(Data_2rur(:,12));
   nanstd(Data_2rur(:,12));
   nanmax(Data_2rur(:,12));
   nanmin(Data_2rur(:,12))];

EnergyUse_2rur=histc(Data_2rur(:,16:18), unique(Data_2rur(:,16:18)))./n_2rur;

T1_2rur=SpendMatrix_2rur; %This table shows the spend matrix in each energy
T2_2rur=LPGStats_2rur; %This table shows the LPG stats
T3_2rur=EnergyUse_2rur; %This table shows the % of each energetic for cooking, heating and lighting

% Samangan Code 3
Data_3=Data(Data(:,2)==18,:);
[n_3 col_3] = size(Data_3);

SpendMatrix_3=[nanmean(Data_3(:,4:10));
   nanstd(Data_3(:,4:10));
   nanmax(Data_3(:,4:10));
   nanmin(Data_3(:,4:10))];

LPGStats_3=[nanmean(Data_3(:,12));
   nanstd(Data_3(:,12));
   nanmax(Data_3(:,12));
   nanmin(Data_3(:,12))];

EnergyUse_3=histc(Data_3(:,16:18), unique(Data_3(:,16:18)))./n_3;

T1_3=SpendMatrix_3; %This table shows the spend matrix in each energy
T2_3=LPGStats_3; %This table shows the LPG stats
T3_3=EnergyUse_3; %This table shows the % of each energetic for cooking, heating and lighting

Data_3urb=Data_3(Data_3(:,3)==1,:);
[n_3urb col_3urb] = size(Data_3urb);

SpendMatrix_3urb=[nanmean(Data_3urb(:,4:10));
   nanstd(Data_3urb(:,4:10));
   nanmax(Data_3urb(:,4:10));
   nanmin(Data_3urb(:,4:10))];
```

```
LPGStats_3urb=[nanmean(Data_3urb(:,12));
   nanstd(Data_3urb(:,12));
   nanmax(Data_3urb(:,12));
   nanmin(Data_3urb(:,12))];

EnergyUse_3urb=histc(Data_3urb(:,16:18), unique(Data_3urb(:,16:18)))./n_3urb;

T1_3urb=SpendMatrix_3urb; %This table shows the spend matrix in each energy
T2_3urb=LPGStats_3urb; %This table shows the LPG stats
T3_3urb=EnergyUse_3urb; %This table shows the % of each energetic for cooking, heating and
lighting

Data_3rur=Data_3(Data_3(:,3)==2,:);
[n_3rur col_3rur] = size(Data_3rur);

SpendMatrix_3rur=[nanmean(Data_3rur(:,4:10));
   nanstd(Data_3rur(:,4:10));
   nanmax(Data_3rur(:,4:10));
   nanmin(Data_3rur(:,4:10))];

LPGStats_3rur=[nanmean(Data_3rur(:,12));
   nanstd(Data_3rur(:,12));
   nanmax(Data_3rur(:,12));
   nanmin(Data_3rur(:,12))];

EnergyUse_3rur=histc(Data_3rur(:,16:18), unique(Data_3rur(:,16:18)))./n_3rur;

T1_3rur=SpendMatrix_3rur; %This table shows the spend matrix in each energy
T2_3rur=LPGStats_3rur; %This table shows the LPG stats
T3_3rur=EnergyUse_3rur; %This table shows the % of each energetic for cooking, heating and lighting

% Baghlam Code 4

Data_4=Data(Data(:,2)==16,:);
[n_4 col_4] = size(Data_4);

SpendMatrix_4=[nanmean(Data_4(:,4:10));
   nanstd(Data_4(:,4:10));
   nanmax(Data_4(:,4:10));
   nanmin(Data_4(:,4:10))];

LPGStats_4=[nanmean(Data_4(:,12));
   nanstd(Data_4(:,12));
   nanmax(Data_4(:,12));
   nanmin(Data_4(:,12))];

EnergyUse_4=histc(Data_4(:,16:18), unique(Data_4(:,16:18)))./n_4;

T1_4=SpendMatrix_4; %This table shows the spend matrix in each energy
T2_4=LPGStats_4; %This table shows the LPG stats
```

```
T3_4=EnergyUse_4; %This table shows the % of each energetic for cooking, heating and lighting

Data_4urb=Data_4(Data_4(:,3)==1,:);
[n_4urb col_4urb] = size(Data_4urb);

SpendMatrix_4urb=[nanmean(Data_4urb(:,4:10));
   nanstd(Data_4urb(:,4:10));
   nanmax(Data_4urb(:,4:10));
   nanmin(Data_4urb(:,4:10))];

LPGStats_4urb=[nanmean(Data_4urb(:,12));
   nanstd(Data_4urb(:,12));
   nanmax(Data_4urb(:,12));
   nanmin(Data_4urb(:,12))];

EnergyUse_4urb=histc(Data_4urb(:,16:18), unique(Data_4urb(:,16:18)))./n_4urb;

T1_4urb=SpendMatrix_4urb; %This table shows the spend matrix in each energy
T2_4urb=LPGStats_4urb; %This table shows the LPG stats
T3_4urb=EnergyUse_4urb; %This table shows the % of each energetic for cooking, heating and
lighting

Data_4rur=Data_4(Data_4(:,3)==2,:);
[n_4rur col_4rur] = size(Data_4rur);

SpendMatrix_4rur=[nanmean(Data_4rur(:,4:10));
   nanstd(Data_4rur(:,4:10));
   nanmax(Data_4rur(:,4:10));
   nanmin(Data_4rur(:,4:10))];

LPGStats_4rur=[nanmean(Data_4rur(:,12));
   nanstd(Data_4rur(:,12));
   nanmax(Data_4rur(:,12));
   nanmin(Data_4rur(:,12))];

EnergyUse_4rur=histc(Data_4rur(:,16:18), unique(Data_4rur(:,16:18)))./n_4rur;

T1_4rur=SpendMatrix_4rur; %This table shows the spend matrix in each energy
T2_4rur=LPGStats_4rur; %This table shows the LPG stats
T3_4rur=EnergyUse_4rur; %This table shows the % of each energetic for cooking, heating and lighting

% Kubduz Code 5

Data_5=Data(Data(:,2)==17,:);
[n_5 col_5] = size(Data_5);

SpendMatrix_5=[nanmean(Data_5(:,4:10));
   nanstd(Data_5(:,4:10));
   nanmax(Data_5(:,4:10));
   nanmin(Data_5(:,4:10))];
```

```
LPGStats_5=[nanmean(Data_5(:,12));
   nanstd(Data_5(:,12));
   nanmax(Data_5(:,12));
   nanmin(Data_5(:,12))];

EnergyUse_5=histc(Data_5(:,16:18), unique(Data_5(:,16:18)))./n_5;

T1_5=SpendMatrix_5; %This table shows the spend matrix in each energy
T2_5=LPGStats_5; %This table shows the LPG stats
T3_5=EnergyUse_5; %This table shows the % of each energetic for cooking, heating and lighting

Data_5urb=Data_5(Data_5(:,3)==1,:);
[n_5urb col_5urb] = size(Data_5urb);

SpendMatrix_5urb=[nanmean(Data_5urb(:,4:10));
   nanstd(Data_5urb(:,4:10));
   nanmax(Data_5urb(:,4:10));
   nanmin(Data_5urb(:,4:10))];

LPGStats_5urb=[nanmean(Data_5urb(:,12));
   nanstd(Data_5urb(:,12));
   nanmax(Data_5urb(:,12));
   nanmin(Data_5urb(:,12))];

EnergyUse_5urb=histc(Data_5urb(:,16:18), unique(Data_5urb(:,16:18)))./n_5urb;

T1_5urb=SpendMatrix_5urb; %This table shows the spend matrix in each energy
T2_5urb=LPGStats_5urb; %This table shows the LPG stats
T3_5urb=EnergyUse_5urb; %This table shows the % of each energetic for cooking, heating and
lighting

Data_5rur=Data_5(Data_5(:,3)==2,:);
[n_5rur col_5rur] = size(Data_5rur);

SpendMatrix_5rur=[nanmean(Data_5rur(:,4:10));
   nanstd(Data_5rur(:,4:10));
   nanmax(Data_5rur(:,4:10));
   nanmin(Data_5rur(:,4:10))];

LPGStats_5rur=[nanmean(Data_5rur(:,12));
   nanstd(Data_5rur(:,12));
   nanmax(Data_5rur(:,12));
   nanmin(Data_5rur(:,12))];

EnergyUse_5rur=histc(Data_5rur(:,16:18), unique(Data_5rur(:,16:18)))./n_5rur;

T1_5rur=SpendMatrix_5rur; %This table shows the spend matrix in each energy
T2_5rur=LPGStats_5rur; %This table shows the LPG stats
T3_5rur=EnergyUse_5rur; %This table shows the % of each energetic for cooking, heating and lighting

% Parwan Code 6
```

```
Data_6=Data(Data(:,2)==3,:);
[n_6 col_6] = size(Data_6);

SpendMatrix_6=[nanmean(Data_6(:,4:10));
   nanstd(Data_6(:,4:10));
   nanmax(Data_6(:,4:10));
   nanmin(Data_6(:,4:10))];

LPGStats_6=[nanmean(Data_6(:,12));
   nanstd(Data_6(:,12));
   nanmax(Data_6(:,12));
   nanmin(Data_6(:,12))];

EnergyUse_6=histc(Data_6(:,16:18), unique(Data_6(:,16:18)))./n_6;

T1_6=SpendMatrix_6; %This table shows the spend matrix in each energy
T2_6=LPGStats_6; %This table shows the LPG stats
T3_6=EnergyUse_6; %This table shows the % of each energetic for cooking, heating and lighting

Data_6urb=Data_6(Data_6(:,3)==1,:);
[n_6urb col_6urb] = size(Data_6urb);

SpendMatrix_6urb=[nanmean(Data_6urb(:,4:10));
   nanstd(Data_6urb(:,4:10));
   nanmax(Data_6urb(:,4:10));
   nanmin(Data_6urb(:,4:10))];

LPGStats_6urb=[nanmean(Data_6urb(:,12));
   nanstd(Data_6urb(:,12));
   nanmax(Data_6urb(:,12));
   nanmin(Data_6urb(:,12))];

EnergyUse_6urb=histc(Data_6urb(:,16:18), unique(Data_6urb(:,16:18)))./n_6urb;

T1_6urb=SpendMatrix_6urb; %This table shows the spend matrix in each energy
T2_6urb=LPGStats_6urb; %This table shows the LPG stats
T3_6urb=EnergyUse_6urb; %This table shows the % of each energetic for cooking, heating and
lighting

Data_6rur=Data_6(Data_6(:,3)==2,:);
[n_6rur col_6rur] = size(Data_6rur);

SpendMatrix_6rur=[nanmean(Data_6rur(:,4:10));
   nanstd(Data_6rur(:,4:10));
   nanmax(Data_6rur(:,4:10));
   nanmin(Data_6rur(:,4:10))];

LPGStats_6rur=[nanmean(Data_6rur(:,12));
   nanstd(Data_6rur(:,12));
   nanmax(Data_6rur(:,12));
```

```
    nanmin(Data_6rur(:,12))];

EnergyUse_6rur=histc(Data_6rur(:,16:18), unique(Data_6rur(:,16:18)))./n_6rur;

T1_6rur=SpendMatrix_6rur; %This table shows the spend matrix in each energy
T2_6rur=LPGStats_6rur; %This table shows the LPG stats
T3_6rur=EnergyUse_6rur; %This table shows the % of each energetic for cooking, heating and lighting

% Kabul Code 7

Data_7=Data(Data(:,2)==1,:);
[n_7 col_7] = size(Data_7);

SpendMatrix_7=[nanmean(Data_7(:,4:10));
    nanstd(Data_7(:,4:10));
    nanmax(Data_7(:,4:10));
    nanmin(Data_7(:,4:10))];

LPGStats_7=[nanmean(Data_7(:,12));
    nanstd(Data_7(:,12));
    nanmax(Data_7(:,12));
    nanmin(Data_7(:,12))];

EnergyUse_7=histc(Data_7(:,16:18), unique(Data_7(:,16:18)))./n_7;

T1_7=SpendMatrix_7; %This table shows the spend matrix in each energy
T2_7=LPGStats_7; %This table shows the LPG stats
T3_7=EnergyUse_7; %This table shows the % of each energetic for cooking, heating and lighting

Data_7urb=Data_7(Data_7(:,3)==1,:);
[n_7urb col_7urb] = size(Data_7urb);

SpendMatrix_7urb=[nanmean(Data_7urb(:,4:10));
    nanstd(Data_7urb(:,4:10));
    nanmax(Data_7urb(:,4:10));
    nanmin(Data_7urb(:,4:10))];

LPGStats_7urb=[nanmean(Data_7urb(:,12));
    nanstd(Data_7urb(:,12));
    nanmax(Data_7urb(:,12));
    nanmin(Data_7urb(:,12))];

EnergyUse_7urb=histc(Data_7urb(:,16:18), unique(Data_7urb(:,16:18)))./n_7urb;

T1_7urb=SpendMatrix_7urb; %This table shows the spend matrix in each energy
T2_7urb=LPGStats_7urb; %This table shows the LPG stats
T3_7urb=EnergyUse_7urb; %This table shows the % of each energetic for cooking, heating and
lighting

Data_7rur=Data_7(Data_7(:,3)==2,:);
[n_7rur col_7rur] = size(Data_7rur);
```

```
SpendMatrix_7rur=[nanmean(Data_7rur(:,4:10));
   nanstd(Data_7rur(:,4:10));
   nanmax(Data_7rur(:,4:10));
   nanmin(Data_7rur(:,4:10))];

LPGStats_7rur=[nanmean(Data_7rur(:,12));
   nanstd(Data_7rur(:,12));
   nanmax(Data_7rur(:,12));
   nanmin(Data_7rur(:,12))];

EnergyUse_7rur=histc(Data_7rur(:,16:18), unique(Data_7rur(:,16:18)))./n_7rur;

T1_7rur=SpendMatrix_7rur; %This table shows the spend matrix in each energy
T2_7rur=LPGStats_7rur; %This table shows the LPG stats
T3_7rur=EnergyUse_7rur; %This table shows the % of each energetic for cooking, heating and lighting


% Analysis of the use of different energies to cook, heat and light

%Cook

Energy=zeros(10,1);
for i=1:sfe;
   if Data(i,16)==1;
      Energy(1,1)=Energy(1,1)+1;
   end;
   if Data(i,16)==2;
      Energy(2,1)=Energy(2,1)+1;
   end;
   if Data(i,16)==3;
      Energy(3,1)=Energy(3,1)+1;
   end;
   if Data(i,16)==4;
      Energy(4,1)=Energy(4,1)+1;
   end;
   if Data(i,16)==5;
      Energy(5,1)=Energy(5,1)+1;
   end;
   if Data(i,16)==6;
      Energy(6,1)=Energy(6,1)+1;
   end;
   if Data(i,16)==7;
      Energy(7,1)=Energy(7,1)+1;
   end;
   if Data(i,16)==8;
      Energy(8,1)=Energy(8,1)+1;
   end;
   if Data(i,16)==9;
      Energy(9,1)=Energy(9,1)+1;
   end;
```

```
    if Data(i,16)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
end;

EnergyU=zeros(10,1);
for i=1:nUrb;
    if DataUrb(i,16)==1;
        EnergyU(1,1)=EnergyU(1,1)+1;
    end;
    if DataUrb(i,16)==2;
        EnergyU(2,1)=EnergyU(2,1)+1;
    end;
    if DataUrb(i,16)==3;
        EnergyU(3,1)=EnergyU(3,1)+1;
    end;
    if DataUrb(i,16)==4;
        EnergyU(4,1)=EnergyU(4,1)+1;
    end;
    if DataUrb(i,16)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if DataUrb(i,16)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if DataUrb(i,16)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if DataUrb(i,16)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if DataUrb(i,16)==9;
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if DataUrb(i,16)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;

EnergyR=zeros(10,1);
for i=1:nRur;
    if DataRur(i,16)==1;
        EnergyR(1,1)=EnergyR(1,1)+1;
    end;
    if DataRur(i,16)==2;
        EnergyR(2,1)=EnergyR(2,1)+1;
    end;
    if DataRur(i,16)==3;
        EnergyR(3,1)=EnergyR(3,1)+1;
    end;
    if DataRur(i,16)==4;
```

```
        EnergyR(4,1)=EnergyR(4,1)+1;
    end;
    if DataRur(i,16)==5;
        EnergyR(5,1)=EnergyR(5,1)+1;
    end;
    if DataRur(i,16)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if DataRur(i,16)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if DataRur(i,16)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if DataRur(i,16)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if DataRur(i,16)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/nRur;
EnergyU=EnergyU/nUrb;
Energy=Energy/sfe;

EnergyT=[EnergyR EnergyU Energy];

% By Province

Energy=zeros(10,1);
for i=1:n_1;
    if Data_1(i,16)==1;
        Energy(1,1)=Energy(1,1)+1;
    end;
    if Data_1(i,16)==2;
        Energy(2,1)=Energy(2,1)+1;
    end;
    if Data_1(i,16)==3;
        Energy(3,1)=Energy(3,1)+1;
    end;
    if Data_1(i,16)==4;
        Energy(4,1)=Energy(4,1)+1;
    end;
    if Data_1(i,16)==5;
        Energy(5,1)=Energy(5,1)+1;
    end;
    if Data_1(i,16)==6;
        Energy(6,1)=Energy(6,1)+1;
    end;
    if Data_1(i,16)==7;
```

```
        Energy(7,1)=Energy(7,1)+1;
    end;
    if Data_1(i,16)==8;
        Energy(8,1)=Energy(8,1)+1;
    end;
    if Data_1(i,16)==9;
        Energy(9,1)=Energy(9,1)+1;
    end;
    if Data_1(i,16)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
end;

EnergyU=zeros(10,1);
for i=1:n_1urb;
    if Data_1urb(i,16)==1;
        EnergyU(1,1)=EnergyU(1,1)+1;
    end;
    if Data_1urb(i,16)==2;
        EnergyU(2,1)=EnergyU(2,1)+1;
    end;
    if Data_1urb(i,16)==3;
        EnergyU(3,1)=EnergyU(3,1)+1;
    end;
    if Data_1urb(i,16)==4;
        EnergyU(4,1)=EnergyU(4,1)+1;
    end;
    if Data_1urb(i,16)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if Data_1urb(i,16)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if Data_1urb(i,16)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if Data_1urb(i,16)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if Data_1urb(i,16)==9;
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if Data_1urb(i,16)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;

EnergyR=zeros(10,1);
for i=1:n_1rur;
    if Data_1rur(i,16)==1;
        EnergyR(1,1)=EnergyR(1,1)+1;
```

```
    end;
    if Data_1rur(i,16)==2;
        EnergyR(2,1)=EnergyR(2,1)+1;
    end;
    if Data_1rur(i,16)==3;
        EnergyR(3,1)=EnergyR(3,1)+1;
    end;
    if Data_1rur(i,16)==4;
        EnergyR(4,1)=EnergyR(4,1)+1;
    end;
    if Data_1rur(i,16)==5;
        EnergyR(5,1)=EnergyR(5,1)+1;
    end;
    if Data_1rur(i,16)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if Data_1rur(i,16)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if Data_1rur(i,16)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if Data_1rur(i,16)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if Data_1rur(i,16)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/n_1rur;
EnergyU=EnergyU/n_1urb;
Energy=Energy/n_1;

EnergyT_1=[EnergyR EnergyU Energy];

Energy=zeros(10,1);
for i=1:n_2;
    if Data_2(i,16)==1;
        Energy(1,1)=Energy(1,1)+1;
    end;
    if Data_2(i,16)==2;
        Energy(2,1)=Energy(2,1)+1;
    end;
    if Data_2(i,16)==3;
        Energy(3,1)=Energy(3,1)+1;
    end;
    if Data_2(i,16)==4;
        Energy(4,1)=Energy(4,1)+1;
    end;
    if Data_2(i,16)==5;
```

```
        Energy(5,1)=Energy(5,1)+1;
    end;
    if Data_2(i,16)==6;
        Energy(6,1)=Energy(6,1)+1;
    end;
    if Data_2(i,16)==7;
        Energy(7,1)=Energy(7,1)+1;
    end;
    if Data_2(i,16)==8;
        Energy(8,1)=Energy(8,1)+1;
    end;
    if Data_2(i,16)==9;
        Energy(9,1)=Energy(9,1)+1;
    end;
    if Data_2(i,16)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
end;

EnergyU=zeros(10,1);
for i=1:n_2urb;
    if Data_2urb(i,16)==1;
        EnergyU(1,1)=EnergyU(1,1)+1;
    end;
    if Data_2urb(i,16)==2;
        EnergyU(2,1)=EnergyU(2,1)+1;
    end;
    if Data_2urb(i,16)==3;
        EnergyU(3,1)=EnergyU(3,1)+1;
    end;
    if Data_2urb(i,16)==4;
        EnergyU(4,1)=EnergyU(4,1)+1;
    end;
    if Data_2urb(i,16)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if Data_2urb(i,16)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if Data_2urb(i,16)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if Data_2urb(i,16)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if Data_2urb(i,16)==9;
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if Data_2urb(i,16)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
```

```
end;

EnergyR=zeros(10,1);
for i=1:n_2rur;
   if Data_2rur(i,16)==1;
      EnergyR(1,1)=EnergyR(1,1)+1;
   end;
   if Data_2rur(i,16)==2;
      EnergyR(2,1)=EnergyR(2,1)+1;
   end;
   if Data_2rur(i,16)==3;
      EnergyR(3,1)=EnergyR(3,1)+1;
   end;
   if Data_2rur(i,16)==4;
      EnergyR(4,1)=EnergyR(4,1)+1;
   end;
   if Data_2rur(i,16)==5;
      EnergyR(5,1)=EnergyR(5,1)+1;
   end;
   if Data_2rur(i,16)==6;
      EnergyR(6,1)=EnergyR(6,1)+1;
   end;
   if Data_2rur(i,16)==7;
      EnergyR(7,1)=EnergyR(7,1)+1;
   end;
   if Data_2rur(i,16)==8;
      EnergyR(8,1)=EnergyR(8,1)+1;
   end;
   if Data_2rur(i,16)==9;
      EnergyR(9,1)=EnergyR(9,1)+1;
   end;
   if Data_2rur(i,16)==10;
      EnergyR(10,1)=EnergyR(10,1)+1;
   end;
end;

EnergyR=EnergyR/n_2rur;
EnergyU=EnergyU/n_2urb;
Energy=Energy/n_2;

EnergyT_2=[EnergyR EnergyU Energy];


Energy=zeros(10,1);
for i=1:n_3;
   if Data_3(i,16)==1;
      Energy(1,1)=Energy(1,1)+1;
   end;
   if Data_3(i,16)==2;
      Energy(2,1)=Energy(2,1)+1;
   end;
```

```
    if Data_3(i,16)==3;
        Energy(3,1)=Energy(3,1)+1;
    end;
    if Data_3(i,16)==4;
        Energy(4,1)=Energy(4,1)+1;
    end;
    if Data_3(i,16)==5;
        Energy(5,1)=Energy(5,1)+1;
    end;
    if Data_3(i,16)==6;
        Energy(6,1)=Energy(6,1)+1;
    end;
    if Data_3(i,16)==7;
        Energy(7,1)=Energy(7,1)+1;
    end;
    if Data_3(i,16)==8;
        Energy(8,1)=Energy(8,1)+1;
    end;
    if Data_3(i,16)==9;
        Energy(9,1)=Energy(9,1)+1;
    end;
    if Data_3(i,16)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
end;

EnergyU=zeros(10,1);
for i=1:n_3urb;
    if Data_3urb(i,16)==1;
        EnergyU(1,1)=EnergyU(1,1)+1;
    end;
    if Data_3urb(i,16)==2;
        EnergyU(2,1)=EnergyU(2,1)+1;
    end;
    if Data_3urb(i,16)==3;
        EnergyU(3,1)=EnergyU(3,1)+1;
    end;
    if Data_3urb(i,16)==4;
        EnergyU(4,1)=EnergyU(4,1)+1;
    end;
    if Data_3urb(i,16)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if Data_3urb(i,16)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if Data_3urb(i,16)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if Data_3urb(i,16)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
```

```
    end;
    if Data_3urb(i,16)==9;
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if Data_3urb(i,16)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;

EnergyR=zeros(10,1);
for i=1:n_3rur;
    if Data_3rur(i,16)==1;
        EnergyR(1,1)=EnergyR(1,1)+1;
    end;
    if Data_3rur(i,16)==2;
        EnergyR(2,1)=EnergyR(2,1)+1;
    end;
    if Data_3rur(i,16)==3;
        EnergyR(3,1)=EnergyR(3,1)+1;
    end;
    if Data_3rur(i,16)==4;
        EnergyR(4,1)=EnergyR(4,1)+1;
    end;
    if Data_3rur(i,16)==5;
        EnergyR(5,1)=EnergyR(5,1)+1;
    end;
    if Data_3rur(i,16)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if Data_3rur(i,16)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if Data_3rur(i,16)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if Data_3rur(i,16)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if Data_3rur(i,16)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/n_3rur;
EnergyU=EnergyU/n_3urb;
Energy=Energy/n_3;

EnergyT_3=[EnergyR EnergyU Energy];


Energy=zeros(10,1);
```

```
for i=1:n_4;
   if Data_4(i,16)==1;
      Energy(1,1)=Energy(1,1)+1;
   end;
   if Data_4(i,16)==2;
      Energy(2,1)=Energy(2,1)+1;
   end;
   if Data_4(i,16)==3;
      Energy(3,1)=Energy(3,1)+1;
   end;
   if Data_4(i,16)==4;
      Energy(4,1)=Energy(4,1)+1;
   end;
   if Data_4(i,16)==5;
      Energy(5,1)=Energy(5,1)+1;
   end;
   if Data_4(i,16)==6;
      Energy(6,1)=Energy(6,1)+1;
   end;
   if Data_4(i,16)==7;
      Energy(7,1)=Energy(7,1)+1;
   end;
   if Data_4(i,16)==8;
      Energy(8,1)=Energy(8,1)+1;
   end;
   if Data_4(i,16)==9;
      Energy(9,1)=Energy(9,1)+1;
   end;
   if Data_4(i,16)==10;
      Energy(10,1)=Energy(10,1)+1;
   end;
end;

EnergyU=zeros(10,1);
for i=1:n_4urb;
   if Data_4urb(i,16)==1;
      EnergyU(1,1)=EnergyU(1,1)+1;
   end;
   if Data_4urb(i,16)==2;
      EnergyU(2,1)=EnergyU(2,1)+1;
   end;
   if Data_4urb(i,16)==3;
      EnergyU(3,1)=EnergyU(3,1)+1;
   end;
   if Data_4urb(i,16)==4;
      EnergyU(4,1)=EnergyU(4,1)+1;
   end;
   if Data_4urb(i,16)==5;
      EnergyU(5,1)=EnergyU(5,1)+1;
   end;
   if Data_4urb(i,16)==6;
```

```
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if Data_4urb(i,16)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if Data_4urb(i,16)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if Data_4urb(i,16)==9;
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if Data_4urb(i,16)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;

EnergyR=zeros(10,1);
for i=1:n_4rur;
    if Data_4rur(i,16)==1;
        EnergyR(1,1)=EnergyR(1,1)+1;
    end;
    if Data_4rur(i,16)==2;
        EnergyR(2,1)=EnergyR(2,1)+1;
    end;
    if Data_4rur(i,16)==3;
        EnergyR(3,1)=EnergyR(3,1)+1;
    end;
    if Data_4rur(i,16)==4;
        EnergyR(4,1)=EnergyR(4,1)+1;
    end;
    if Data_4rur(i,16)==5;
        EnergyR(5,1)=EnergyR(5,1)+1;
    end;
    if Data_4rur(i,16)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if Data_4rur(i,16)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if Data_4rur(i,16)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if Data_4rur(i,16)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if Data_4rur(i,16)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/n_4rur;
```

```
EnergyU=EnergyU/n_4urb;
Energy=Energy/n_4;

EnergyT_4=[EnergyR EnergyU Energy];


Energy=zeros(10,1);
for i=1:n_5;
   if Data_5(i,16)==1;
      Energy(1,1)=Energy(1,1)+1;
   end;
   if Data_5(i,16)==2;
      Energy(2,1)=Energy(2,1)+1;
   end;
   if Data_5(i,16)==3;
      Energy(3,1)=Energy(3,1)+1;
   end;
   if Data_5(i,16)==4;
      Energy(4,1)=Energy(4,1)+1;
   end;
   if Data_5(i,16)==5;
      Energy(5,1)=Energy(5,1)+1;
   end;
   if Data_5(i,16)==6;
      Energy(6,1)=Energy(6,1)+1;
   end;
   if Data_5(i,16)==7;
      Energy(7,1)=Energy(7,1)+1;
   end;
   if Data_5(i,16)==8;
      Energy(8,1)=Energy(8,1)+1;
   end;
   if Data_5(i,16)==9;
      Energy(9,1)=Energy(9,1)+1;
   end;
   if Data_5(i,16)==10;
      Energy(10,1)=Energy(10,1)+1;
   end;
end;

EnergyU=zeros(10,1);
for i=1:n_5urb;
   if Data_5urb(i,16)==1;
      EnergyU(1,1)=EnergyU(1,1)+1;
   end;
   if Data_5urb(i,16)==2;
      EnergyU(2,1)=EnergyU(2,1)+1;
   end;
   if Data_5urb(i,16)==3;
      EnergyU(3,1)=EnergyU(3,1)+1;
   end;
```

```
    if Data_5urb(i,16)==4;
        EnergyU(4,1)=EnergyU(4,1)+1;
    end;
    if Data_5urb(i,16)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if Data_5urb(i,16)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if Data_5urb(i,16)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if Data_5urb(i,16)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if Data_5urb(i,16)==9;
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if Data_5urb(i,16)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;

EnergyR=zeros(10,1);
for i=1:n_5rur;
    if Data_5rur(i,16)==1;
        EnergyR(1,1)=EnergyR(1,1)+1;
    end;
    if Data_5rur(i,16)==2;
        EnergyR(2,1)=EnergyR(2,1)+1;
    end;
    if Data_5rur(i,16)==3;
        EnergyR(3,1)=EnergyR(3,1)+1;
    end;
    if Data_5rur(i,16)==4;
        EnergyR(4,1)=EnergyR(4,1)+1;
    end;
    if Data_5rur(i,16)==5;
        EnergyR(5,1)=EnergyR(5,1)+1;
    end;
    if Data_5rur(i,16)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if Data_5rur(i,16)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if Data_5rur(i,16)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if Data_5rur(i,16)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
```

```
    end;
    if Data_5rur(i,16)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/n_5rur;
EnergyU=EnergyU/n_5urb;
Energy=Energy/n_5;

EnergyT_5=[EnergyR EnergyU Energy];


Energy=zeros(10,1);
for i=1:n_6;
    if Data_6(i,16)==1;
        Energy(1,1)=Energy(1,1)+1;
    end;
    if Data_6(i,16)==2;
        Energy(2,1)=Energy(2,1)+1;
    end;
    if Data_6(i,16)==3;
        Energy(3,1)=Energy(3,1)+1;
    end;
    if Data_6(i,16)==4;
        Energy(4,1)=Energy(4,1)+1;
    end;
    if Data_6(i,16)==5;
        Energy(5,1)=Energy(5,1)+1;
    end;
    if Data_6(i,16)==6;
        Energy(6,1)=Energy(6,1)+1;
    end;
    if Data_6(i,16)==7;
        Energy(7,1)=Energy(7,1)+1;
    end;
    if Data_6(i,16)==8;
        Energy(8,1)=Energy(8,1)+1;
    end;
    if Data_6(i,16)==9;
        Energy(9,1)=Energy(9,1)+1;
    end;
    if Data_6(i,16)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
end;

EnergyU=zeros(10,1);
for i=1:n_6urb;
    if Data_6urb(i,16)==1;
        EnergyU(1,1)=EnergyU(1,1)+1;
```

```
    end;
    if Data_6urb(i,16)==2;
        EnergyU(2,1)=EnergyU(2,1)+1;
    end;
    if Data_6urb(i,16)==3;
        EnergyU(3,1)=EnergyU(3,1)+1;
    end;
    if Data_6urb(i,16)==4;
        EnergyU(4,1)=EnergyU(4,1)+1;
    end;
    if Data_6urb(i,16)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if Data_6urb(i,16)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if Data_6urb(i,16)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if Data_6urb(i,16)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if Data_6urb(i,16)==9;
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if Data_6urb(i,16)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;

EnergyR=zeros(10,1);
for i=1:n_6rur;
    if Data_6rur(i,16)==1;
        EnergyR(1,1)=EnergyR(1,1)+1;
    end;
    if Data_6rur(i,16)==2;
        EnergyR(2,1)=EnergyR(2,1)+1;
    end;
    if Data_6rur(i,16)==3;
        EnergyR(3,1)=EnergyR(3,1)+1;
    end;
    if Data_6rur(i,16)==4;
        EnergyR(4,1)=EnergyR(4,1)+1;
    end;
    if Data_6rur(i,16)==5;
        EnergyR(5,1)=EnergyR(5,1)+1;
    end;
    if Data_6rur(i,16)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if Data_6rur(i,16)==7;
```

```
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if Data_6rur(i,16)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if Data_6rur(i,16)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if Data_6rur(i,16)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/n_6rur;
EnergyU=EnergyU/n_6urb;
Energy=Energy/n_6;

EnergyT_6=[EnergyR EnergyU Energy];

Energy=zeros(10,1);
for i=1:n_7;
    if Data_7(i,16)==1;
        Energy(1,1)=Energy(1,1)+1;
    end;
    if Data_7(i,16)==2;
        Energy(2,1)=Energy(2,1)+1;
    end;
    if Data_7(i,16)==3;
        Energy(3,1)=Energy(3,1)+1;
    end;
    if Data_7(i,16)==4;
        Energy(4,1)=Energy(4,1)+1;
    end;
    if Data_7(i,16)==5;
        Energy(5,1)=Energy(5,1)+1;
    end;
    if Data_7(i,16)==6;
        Energy(6,1)=Energy(6,1)+1;
    end;
    if Data_7(i,16)==7;
        Energy(7,1)=Energy(7,1)+1;
    end;
    if Data_7(i,16)==8;
        Energy(8,1)=Energy(8,1)+1;
    end;
    if Data_7(i,16)==9;
        Energy(9,1)=Energy(9,1)+1;
    end;
    if Data_7(i,16)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
```

```
end;

EnergyU=zeros(10,1);
for i=1:n_7urb;
   if Data_7urb(i,16)==1;
      EnergyU(1,1)=EnergyU(1,1)+1;
   end;
   if Data_7urb(i,16)==2;
      EnergyU(2,1)=EnergyU(2,1)+1;
   end;
   if Data_7urb(i,16)==3;
      EnergyU(3,1)=EnergyU(3,1)+1;
   end;
   if Data_7urb(i,16)==4;
      EnergyU(4,1)=EnergyU(4,1)+1;
   end;
   if Data_7urb(i,16)==5;
      EnergyU(5,1)=EnergyU(5,1)+1;
   end;
   if Data_7urb(i,16)==6;
      EnergyU(6,1)=EnergyU(6,1)+1;
   end;
   if Data_7urb(i,16)==7;
      EnergyU(7,1)=EnergyU(7,1)+1;
   end;
   if Data_7urb(i,16)==8;
      EnergyU(8,1)=EnergyU(8,1)+1;
   end;
   if Data_7urb(i,16)==9;
      EnergyU(9,1)=EnergyU(9,1)+1;
   end;
   if Data_7urb(i,16)==10;
      EnergyU(10,1)=EnergyU(10,1)+1;
   end;
end;

EnergyR=zeros(10,1);
for i=1:n_7rur;
   if Data_7rur(i,16)==1;
      EnergyR(1,1)=EnergyR(1,1)+1;
   end;
   if Data_7rur(i,16)==2;
      EnergyR(2,1)=EnergyR(2,1)+1;
   end;
   if Data_7rur(i,16)==3;
      EnergyR(3,1)=EnergyR(3,1)+1;
   end;
   if Data_7rur(i,16)==4;
      EnergyR(4,1)=EnergyR(4,1)+1;
   end;
   if Data_7rur(i,16)==5;
```

```
        EnergyR(5,1)=EnergyR(5,1)+1;
    end;
    if Data_7rur(i,16)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if Data_7rur(i,16)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if Data_7rur(i,16)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if Data_7rur(i,16)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if Data_7rur(i,16)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/n_7rur;
EnergyU=EnergyU/n_7urb;
Energy=Energy/n_7;

EnergyT_7=[EnergyR EnergyU Energy];

%Cook

Energy=zeros(10,1);
for i=1:sfe;
    if Data(i,17)==1;
        Energy(1,1)=Energy(1,1)+1;
    end;
    if Data(i,17)==2;
        Energy(2,1)=Energy(2,1)+1;
    end;
    if Data(i,17)==3;
        Energy(3,1)=Energy(3,1)+1;
    end;
    if Data(i,17)==4;
        Energy(4,1)=Energy(4,1)+1;
    end;
    if Data(i,17)==5;
        Energy(5,1)=Energy(5,1)+1;
    end;
    if Data(i,17)==6;
        Energy(6,1)=Energy(6,1)+1;
    end;
    if Data(i,17)==7;
        Energy(7,1)=Energy(7,1)+1;
    end;
    if Data(i,17)==8;
```

```
        Energy(8,1)=Energy(8,1)+1;
    end;
    if Data(i,17)==9;
        Energy(9,1)=Energy(9,1)+1;
    end;
    if Data(i,17)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
end;

EnergyU=zeros(10,1);
for i=1:nUrb;
    if DataUrb(i,17)==1;
        EnergyU(1,1)=EnergyU(1,1)+1;
    end;
    if DataUrb(i,17)==2;
        EnergyU(2,1)=EnergyU(2,1)+1;
    end;
    if DataUrb(i,17)==3;
        EnergyU(3,1)=EnergyU(3,1)+1;
    end;
    if DataUrb(i,17)==4;
        EnergyU(4,1)=EnergyU(4,1)+1;
    end;
    if DataUrb(i,17)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if DataUrb(i,17)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if DataUrb(i,17)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if DataUrb(i,17)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if DataUrb(i,17)==9;
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if DataUrb(i,17)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;

EnergyR=zeros(10,1);
for i=1:nRur;
    if DataRur(i,17)==1;
        EnergyR(1,1)=EnergyR(1,1)+1;
    end;
    if DataRur(i,17)==2;
        EnergyR(2,1)=EnergyR(2,1)+1;
```

```
    end;
    if DataRur(i,17)==3;
        EnergyR(3,1)=EnergyR(3,1)+1;
    end;
    if DataRur(i,17)==4;
        EnergyR(4,1)=EnergyR(4,1)+1;
    end;
    if DataRur(i,17)==5;
        EnergyR(5,1)=EnergyR(5,1)+1;
    end;
    if DataRur(i,17)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if DataRur(i,17)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if DataRur(i,17)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if DataRur(i,17)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if DataRur(i,17)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/nRur;
EnergyU=EnergyU/nUrb;
Energy=Energy/sfe;

EnergyT1=[EnergyR EnergyU Energy];

% By Province

Energy=zeros(10,1);
for i=1:n_1;
    if Data_1(i,17)==1;
        Energy(1,1)=Energy(1,1)+1;
    end;
    if Data_1(i,17)==2;
        Energy(2,1)=Energy(2,1)+1;
    end;
    if Data_1(i,17)==3;
        Energy(3,1)=Energy(3,1)+1;
    end;
    if Data_1(i,17)==4;
        Energy(4,1)=Energy(4,1)+1;
    end;
    if Data_1(i,17)==5;
        Energy(5,1)=Energy(5,1)+1;
```

```
    end;
    if Data_1(i,17)==6;
        Energy(6,1)=Energy(6,1)+1;
    end;
    if Data_1(i,17)==7;
        Energy(7,1)=Energy(7,1)+1;
    end;
    if Data_1(i,17)==8;
        Energy(8,1)=Energy(8,1)+1;
    end;
    if Data_1(i,17)==9;
        Energy(9,1)=Energy(9,1)+1;
    end;
    if Data_1(i,17)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
end;

EnergyU=zeros(10,1);
for i=1:n_1urb;
    if Data_1urb(i,17)==1;
        EnergyU(1,1)=EnergyU(1,1)+1;
    end;
    if Data_1urb(i,17)==2;
        EnergyU(2,1)=EnergyU(2,1)+1;
    end;
    if Data_1urb(i,17)==3;
        EnergyU(3,1)=EnergyU(3,1)+1;
    end;
    if Data_1urb(i,17)==4;
        EnergyU(4,1)=EnergyU(4,1)+1;
    end;
    if Data_1urb(i,17)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if Data_1urb(i,17)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if Data_1urb(i,17)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if Data_1urb(i,17)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if Data_1urb(i,17)==9;
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if Data_1urb(i,17)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;
```

```
EnergyR=zeros(10,1);
for i=1:n_1rur;
   if Data_1rur(i,17)==1;
      EnergyR(1,1)=EnergyR(1,1)+1;
   end;
   if Data_1rur(i,17)==2;
      EnergyR(2,1)=EnergyR(2,1)+1;
   end;
   if Data_1rur(i,17)==3;
      EnergyR(3,1)=EnergyR(3,1)+1;
   end;
   if Data_1rur(i,17)==4;
      EnergyR(4,1)=EnergyR(4,1)+1;
   end;
   if Data_1rur(i,17)==5;
      EnergyR(5,1)=EnergyR(5,1)+1;
   end;
   if Data_1rur(i,17)==6;
      EnergyR(6,1)=EnergyR(6,1)+1;
   end;
   if Data_1rur(i,17)==7;
      EnergyR(7,1)=EnergyR(7,1)+1;
   end;
   if Data_1rur(i,17)==8;
      EnergyR(8,1)=EnergyR(8,1)+1;
   end;
   if Data_1rur(i,17)==9;
      EnergyR(9,1)=EnergyR(9,1)+1;
   end;
   if Data_1rur(i,17)==10;
      EnergyR(10,1)=EnergyR(10,1)+1;
   end;
end;

EnergyR=EnergyR/n_1rur;
EnergyU=EnergyU/n_1urb;
Energy=Energy/n_1;

EnergyT1_1=[EnergyR EnergyU Energy];

Energy=zeros(10,1);
for i=1:n_2;
   if Data_2(i,17)==1;
      Energy(1,1)=Energy(1,1)+1;
   end;
   if Data_2(i,17)==2;
      Energy(2,1)=Energy(2,1)+1;
   end;
   if Data_2(i,17)==3;
      Energy(3,1)=Energy(3,1)+1;
```

```
    end;
    if Data_2(i,17)==4;
        Energy(4,1)=Energy(4,1)+1;
    end;
    if Data_2(i,17)==5;
        Energy(5,1)=Energy(5,1)+1;
    end;
    if Data_2(i,17)==6;
        Energy(6,1)=Energy(6,1)+1;
    end;
    if Data_2(i,17)==7;
        Energy(7,1)=Energy(7,1)+1;
    end;
    if Data_2(i,17)==8;
        Energy(8,1)=Energy(8,1)+1;
    end;
    if Data_2(i,17)==9;
        Energy(9,1)=Energy(9,1)+1;
    end;
    if Data_2(i,17)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
end;

EnergyU=zeros(10,1);
for i=1:n_2urb;
    if Data_2urb(i,17)==1;
        EnergyU(1,1)=EnergyU(1,1)+1;
    end;
    if Data_2urb(i,17)==2;
        EnergyU(2,1)=EnergyU(2,1)+1;
    end;
    if Data_2urb(i,17)==3;
        EnergyU(3,1)=EnergyU(3,1)+1;
    end;
    if Data_2urb(i,17)==4;
        EnergyU(4,1)=EnergyU(4,1)+1;
    end;
    if Data_2urb(i,17)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if Data_2urb(i,17)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if Data_2urb(i,17)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if Data_2urb(i,17)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if Data_2urb(i,17)==9;
```

```
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if Data_2urb(i,17)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;

EnergyR=zeros(10,1);
for i=1:n_2rur;
    if Data_2rur(i,17)==1;
        EnergyR(1,1)=EnergyR(1,1)+1;
    end;
    if Data_2rur(i,17)==2;
        EnergyR(2,1)=EnergyR(2,1)+1;
    end;
    if Data_2rur(i,17)==3;
        EnergyR(3,1)=EnergyR(3,1)+1;
    end;
    if Data_2rur(i,17)==4;
        EnergyR(4,1)=EnergyR(4,1)+1;
    end;
    if Data_2rur(i,17)==5;
        EnergyR(5,1)=EnergyR(5,1)+1;
    end;
    if Data_2rur(i,17)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if Data_2rur(i,17)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if Data_2rur(i,17)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if Data_2rur(i,17)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if Data_2rur(i,17)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/n_2rur;
EnergyU=EnergyU/n_2urb;
Energy=Energy/n_2;

EnergyT1_2=[EnergyR EnergyU Energy];


Energy=zeros(10,1);
for i=1:n_3;
    if Data_3(i,17)==1;
```

```
        Energy(1,1)=Energy(1,1)+1;
    end;
    if Data_3(i,17)==2;
        Energy(2,1)=Energy(2,1)+1;
    end;
    if Data_3(i,17)==3;
        Energy(3,1)=Energy(3,1)+1;
    end;
    if Data_3(i,17)==4;
        Energy(4,1)=Energy(4,1)+1;
    end;
    if Data_3(i,17)==5;
        Energy(5,1)=Energy(5,1)+1;
    end;
    if Data_3(i,17)==6;
        Energy(6,1)=Energy(6,1)+1;
    end;
    if Data_3(i,17)==7;
        Energy(7,1)=Energy(7,1)+1;
    end;
    if Data_3(i,17)==8;
        Energy(8,1)=Energy(8,1)+1;
    end;
    if Data_3(i,17)==9;
        Energy(9,1)=Energy(9,1)+1;
    end;
    if Data_3(i,17)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
end;

EnergyU=zeros(10,1);
for i=1:n_3urb;
    if Data_3urb(i,17)==1;
        EnergyU(1,1)=EnergyU(1,1)+1;
    end;
    if Data_3urb(i,17)==2;
        EnergyU(2,1)=EnergyU(2,1)+1;
    end;
    if Data_3urb(i,17)==3;
        EnergyU(3,1)=EnergyU(3,1)+1;
    end;
    if Data_3urb(i,17)==4;
        EnergyU(4,1)=EnergyU(4,1)+1;
    end;
    if Data_3urb(i,17)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if Data_3urb(i,17)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
```

```
    if Data_3urb(i,17)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if Data_3urb(i,17)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if Data_3urb(i,17)==9;
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if Data_3urb(i,17)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;

EnergyR=zeros(10,1);
for i=1:n_3rur;
    if Data_3rur(i,17)==1;
        EnergyR(1,1)=EnergyR(1,1)+1;
    end;
    if Data_3rur(i,17)==2;
        EnergyR(2,1)=EnergyR(2,1)+1;
    end;
    if Data_3rur(i,17)==3;
        EnergyR(3,1)=EnergyR(3,1)+1;
    end;
    if Data_3rur(i,17)==4;
        EnergyR(4,1)=EnergyR(4,1)+1;
    end;
    if Data_3rur(i,17)==5;
        EnergyR(5,1)=EnergyR(5,1)+1;
    end;
    if Data_3rur(i,17)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if Data_3rur(i,17)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if Data_3rur(i,17)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if Data_3rur(i,17)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if Data_3rur(i,17)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/n_3rur;
EnergyU=EnergyU/n_3urb;
Energy=Energy/n_3;
```

```
EnergyT1_3=[EnergyR EnergyU Energy];


Energy=zeros(10,1);
for i=1:n_4;
   if Data_4(i,17)==1;
      Energy(1,1)=Energy(1,1)+1;
   end;
   if Data_4(i,17)==2;
      Energy(2,1)=Energy(2,1)+1;
   end;
   if Data_4(i,17)==3;
      Energy(3,1)=Energy(3,1)+1;
   end;
   if Data_4(i,17)==4;
      Energy(4,1)=Energy(4,1)+1;
   end;
   if Data_4(i,17)==5;
      Energy(5,1)=Energy(5,1)+1;
   end;
   if Data_4(i,17)==6;
      Energy(6,1)=Energy(6,1)+1;
   end;
   if Data_4(i,17)==7;
      Energy(7,1)=Energy(7,1)+1;
   end;
   if Data_4(i,17)==8;
      Energy(8,1)=Energy(8,1)+1;
   end;
   if Data_4(i,17)==9;
      Energy(9,1)=Energy(9,1)+1;
   end;
   if Data_4(i,17)==10;
      Energy(10,1)=Energy(10,1)+1;
   end;
end;

EnergyU=zeros(10,1);
for i=1:n_4urb;
   if Data_4urb(i,17)==1;
      EnergyU(1,1)=EnergyU(1,1)+1;
   end;
   if Data_4urb(i,17)==2;
      EnergyU(2,1)=EnergyU(2,1)+1;
   end;
   if Data_4urb(i,17)==3;
      EnergyU(3,1)=EnergyU(3,1)+1;
   end;
   if Data_4urb(i,17)==4;
      EnergyU(4,1)=EnergyU(4,1)+1;
```

```
    end;
    if Data_4urb(i,17)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if Data_4urb(i,17)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if Data_4urb(i,17)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if Data_4urb(i,17)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if Data_4urb(i,17)==9;
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if Data_4urb(i,17)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;

EnergyR=zeros(10,1);
for i=1:n_4rur;
    if Data_4rur(i,17)==1;
        EnergyR(1,1)=EnergyR(1,1)+1;
    end;
    if Data_4rur(i,17)==2;
        EnergyR(2,1)=EnergyR(2,1)+1;
    end;
    if Data_4rur(i,17)==3;
        EnergyR(3,1)=EnergyR(3,1)+1;
    end;
    if Data_4rur(i,17)==4;
        EnergyR(4,1)=EnergyR(4,1)+1;
    end;
    if Data_4rur(i,17)==5;
        EnergyR(5,1)=EnergyR(5,1)+1;
    end;
    if Data_4rur(i,17)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if Data_4rur(i,17)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if Data_4rur(i,17)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if Data_4rur(i,17)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if Data_4rur(i,17)==10;
```

```
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/n_4rur;
EnergyU=EnergyU/n_4urb;
Energy=Energy/n_4;

EnergyT1_4=[EnergyR EnergyU Energy];


Energy=zeros(10,1);
for i=1:n_5;
    if Data_5(i,17)==1;
        Energy(1,1)=Energy(1,1)+1;
    end;
    if Data_5(i,17)==2;
        Energy(2,1)=Energy(2,1)+1;
    end;
    if Data_5(i,17)==3;
        Energy(3,1)=Energy(3,1)+1;
    end;
    if Data_5(i,17)==4;
        Energy(4,1)=Energy(4,1)+1;
    end;
    if Data_5(i,17)==5;
        Energy(5,1)=Energy(5,1)+1;
    end;
    if Data_5(i,17)==6;
        Energy(6,1)=Energy(6,1)+1;
    end;
    if Data_5(i,17)==7;
        Energy(7,1)=Energy(7,1)+1;
    end;
    if Data_5(i,17)==8;
        Energy(8,1)=Energy(8,1)+1;
    end;
    if Data_5(i,17)==9;
        Energy(9,1)=Energy(9,1)+1;
    end;
    if Data_5(i,17)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
end;

EnergyU=zeros(10,1);
for i=1:n_5urb;
    if Data_5urb(i,17)==1;
        EnergyU(1,1)=EnergyU(1,1)+1;
    end;
    if Data_5urb(i,17)==2;
```

```
        EnergyU(2,1)=EnergyU(2,1)+1;
    end;
    if Data_5urb(i,17)==3;
        EnergyU(3,1)=EnergyU(3,1)+1;
    end;
    if Data_5urb(i,17)==4;
        EnergyU(4,1)=EnergyU(4,1)+1;
    end;
    if Data_5urb(i,17)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if Data_5urb(i,17)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if Data_5urb(i,17)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if Data_5urb(i,17)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if Data_5urb(i,17)==9;
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if Data_5urb(i,17)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;

EnergyR=zeros(10,1);
for i=1:n_5rur;
    if Data_5rur(i,17)==1;
        EnergyR(1,1)=EnergyR(1,1)+1;
    end;
    if Data_5rur(i,17)==2;
        EnergyR(2,1)=EnergyR(2,1)+1;
    end;
    if Data_5rur(i,17)==3;
        EnergyR(3,1)=EnergyR(3,1)+1;
    end;
    if Data_5rur(i,17)==4;
        EnergyR(4,1)=EnergyR(4,1)+1;
    end;
    if Data_5rur(i,17)==5;
        EnergyR(5,1)=EnergyR(5,1)+1;
    end;
    if Data_5rur(i,17)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if Data_5rur(i,17)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
```

```
    if Data_5rur(i,17)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if Data_5rur(i,17)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if Data_5rur(i,17)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/n_5rur;
EnergyU=EnergyU/n_5urb;
Energy=Energy/n_5;

EnergyT1_5=[EnergyR EnergyU Energy];


Energy=zeros(10,1);
for i=1:n_6;
    if Data_6(i,17)==1;
        Energy(1,1)=Energy(1,1)+1;
    end;
    if Data_6(i,17)==2;
        Energy(2,1)=Energy(2,1)+1;
    end;
    if Data_6(i,17)==3;
        Energy(3,1)=Energy(3,1)+1;
    end;
    if Data_6(i,17)==4;
        Energy(4,1)=Energy(4,1)+1;
    end;
    if Data_6(i,17)==5;
        Energy(5,1)=Energy(5,1)+1;
    end;
    if Data_6(i,17)==6;
        Energy(6,1)=Energy(6,1)+1;
    end;
    if Data_6(i,17)==7;
        Energy(7,1)=Energy(7,1)+1;
    end;
    if Data_6(i,17)==8;
        Energy(8,1)=Energy(8,1)+1;
    end;
    if Data_6(i,17)==9;
        Energy(9,1)=Energy(9,1)+1;
    end;
    if Data_6(i,17)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
end;
```

```
EnergyU=zeros(10,1);
for i=1:n_6urb;
   if Data_6urb(i,17)==1;
      EnergyU(1,1)=EnergyU(1,1)+1;
   end;
   if Data_6urb(i,17)==2;
      EnergyU(2,1)=EnergyU(2,1)+1;
   end;
   if Data_6urb(i,17)==3;
      EnergyU(3,1)=EnergyU(3,1)+1;
   end;
   if Data_6urb(i,17)==4;
      EnergyU(4,1)=EnergyU(4,1)+1;
   end;
   if Data_6urb(i,17)==5;
      EnergyU(5,1)=EnergyU(5,1)+1;
   end;
   if Data_6urb(i,17)==6;
      EnergyU(6,1)=EnergyU(6,1)+1;
   end;
   if Data_6urb(i,17)==7;
      EnergyU(7,1)=EnergyU(7,1)+1;
   end;
   if Data_6urb(i,17)==8;
      EnergyU(8,1)=EnergyU(8,1)+1;
   end;
   if Data_6urb(i,17)==9;
      EnergyU(9,1)=EnergyU(9,1)+1;
   end;
   if Data_6urb(i,17)==10;
      EnergyU(10,1)=EnergyU(10,1)+1;
   end;
end;

EnergyR=zeros(10,1);
for i=1:n_6rur;
   if Data_6rur(i,17)==1;
      EnergyR(1,1)=EnergyR(1,1)+1;
   end;
   if Data_6rur(i,17)==2;
      EnergyR(2,1)=EnergyR(2,1)+1;
   end;
   if Data_6rur(i,17)==3;
      EnergyR(3,1)=EnergyR(3,1)+1;
   end;
   if Data_6rur(i,17)==4;
      EnergyR(4,1)=EnergyR(4,1)+1;
   end;
   if Data_6rur(i,17)==5;
      EnergyR(5,1)=EnergyR(5,1)+1;
```

```
    end;
    if Data_6rur(i,17)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if Data_6rur(i,17)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if Data_6rur(i,17)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if Data_6rur(i,17)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if Data_6rur(i,17)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/n_6rur;
EnergyU=EnergyU/n_6urb;
Energy=Energy/n_6;

EnergyT1_6=[EnergyR EnergyU Energy];

Energy=zeros(10,1);
for i=1:n_7;
    if Data_7(i,17)==1;
        Energy(1,1)=Energy(1,1)+1;
    end;
    if Data_7(i,17)==2;
        Energy(2,1)=Energy(2,1)+1;
    end;
    if Data_7(i,17)==3;
        Energy(3,1)=Energy(3,1)+1;
    end;
    if Data_7(i,17)==4;
        Energy(4,1)=Energy(4,1)+1;
    end;
    if Data_7(i,17)==5;
        Energy(5,1)=Energy(5,1)+1;
    end;
    if Data_7(i,17)==6;
        Energy(6,1)=Energy(6,1)+1;
    end;
    if Data_7(i,17)==7;
        Energy(7,1)=Energy(7,1)+1;
    end;
    if Data_7(i,17)==8;
        Energy(8,1)=Energy(8,1)+1;
    end;
    if Data_7(i,17)==9;
```

```
        Energy(9,1)=Energy(9,1)+1;
    end;
    if Data_7(i,17)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
end;

EnergyU=zeros(10,1);
for i=1:n_7urb;
    if Data_7urb(i,17)==1;
        EnergyU(1,1)=EnergyU(1,1)+1;
    end;
    if Data_7urb(i,17)==2;
        EnergyU(2,1)=EnergyU(2,1)+1;
    end;
    if Data_7urb(i,17)==3;
        EnergyU(3,1)=EnergyU(3,1)+1;
    end;
    if Data_7urb(i,17)==4;
        EnergyU(4,1)=EnergyU(4,1)+1;
    end;
    if Data_7urb(i,17)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if Data_7urb(i,17)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if Data_7urb(i,17)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if Data_7urb(i,17)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if Data_7urb(i,17)==9;
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if Data_7urb(i,17)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;

EnergyR=zeros(10,1);
for i=1:n_7rur;
    if Data_7rur(i,17)==1;
        EnergyR(1,1)=EnergyR(1,1)+1;
    end;
    if Data_7rur(i,17)==2;
        EnergyR(2,1)=EnergyR(2,1)+1;
    end;
    if Data_7rur(i,17)==3;
        EnergyR(3,1)=EnergyR(3,1)+1;
```

```
    end;
    if Data_7rur(i,17)==4;
        EnergyR(4,1)=EnergyR(4,1)+1;
    end;
    if Data_7rur(i,17)==5;
        EnergyR(5,1)=EnergyR(5,1)+1;
    end;
    if Data_7rur(i,17)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if Data_7rur(i,17)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if Data_7rur(i,17)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if Data_7rur(i,17)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if Data_7rur(i,17)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/n_7rur;
EnergyU=EnergyU/n_7urb;
Energy=Energy/n_7;

EnergyT1_7=[EnergyR EnergyU Energy];


%Light

Energy=zeros(10,1);
for i=1:sfe;
    if Data(i,18)==1;
        Energy(1,1)=Energy(1,1)+1;
    end;
    if Data(i,18)==2;
        Energy(2,1)=Energy(2,1)+1;
    end;
    if Data(i,18)==3;
        Energy(3,1)=Energy(3,1)+1;
    end;
    if Data(i,18)==4;
        Energy(4,1)=Energy(4,1)+1;
    end;
    if Data(i,18)==5;
        Energy(5,1)=Energy(5,1)+1;
    end;
    if Data(i,18)==6;
```

```
        Energy(6,1)=Energy(6,1)+1;
    end;
    if Data(i,18)==7;
        Energy(7,1)=Energy(7,1)+1;
    end;
    if Data(i,18)==8;
        Energy(8,1)=Energy(8,1)+1;
    end;
    if Data(i,18)==9;
        Energy(9,1)=Energy(9,1)+1;
    end;
    if Data(i,18)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
end;

EnergyU=zeros(10,1);
for i=1:nUrb;
    if DataUrb(i,18)==1;
        EnergyU(1,1)=EnergyU(1,1)+1;
    end;
    if DataUrb(i,18)==2;
        EnergyU(2,1)=EnergyU(2,1)+1;
    end;
    if DataUrb(i,18)==3;
        EnergyU(3,1)=EnergyU(3,1)+1;
    end;
    if DataUrb(i,18)==4;
        EnergyU(4,1)=EnergyU(4,1)+1;
    end;
    if DataUrb(i,18)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if DataUrb(i,18)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if DataUrb(i,18)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if DataUrb(i,18)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if DataUrb(i,18)==9;
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if DataUrb(i,18)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;

EnergyR=zeros(10,1);
```

```
for i=1:nRur;
   if DataRur(i,18)==1;
      EnergyR(1,1)=EnergyR(1,1)+1;
   end;
   if DataRur(i,18)==2;
      EnergyR(2,1)=EnergyR(2,1)+1;
   end;
   if DataRur(i,18)==3;
      EnergyR(3,1)=EnergyR(3,1)+1;
   end;
   if DataRur(i,18)==4;
      EnergyR(4,1)=EnergyR(4,1)+1;
   end;
   if DataRur(i,18)==5;
      EnergyR(5,1)=EnergyR(5,1)+1;
   end;
   if DataRur(i,18)==6;
      EnergyR(6,1)=EnergyR(6,1)+1;
   end;
   if DataRur(i,18)==7;
      EnergyR(7,1)=EnergyR(7,1)+1;
   end;
   if DataRur(i,18)==8;
      EnergyR(8,1)=EnergyR(8,1)+1;
   end;
   if DataRur(i,18)==9;
      EnergyR(9,1)=EnergyR(9,1)+1;
   end;
   if DataRur(i,18)==10;
      EnergyR(10,1)=EnergyR(10,1)+1;
   end;
end;

EnergyR=EnergyR/nRur;
EnergyU=EnergyU/nUrb;
Energy=Energy/sfe;

EnergyT2=[EnergyR EnergyU Energy];

% By Province

Energy=zeros(10,1);
for i=1:n_1;
   if Data_1(i,18)==1;
      Energy(1,1)=Energy(1,1)+1;
   end;
   if Data_1(i,18)==2;
      Energy(2,1)=Energy(2,1)+1;
   end;
   if Data_1(i,18)==3;
      Energy(3,1)=Energy(3,1)+1;
```

```
    end;
    if Data_1(i,18)==4;
        Energy(4,1)=Energy(4,1)+1;
    end;
    if Data_1(i,18)==5;
        Energy(5,1)=Energy(5,1)+1;
    end;
    if Data_1(i,18)==6;
        Energy(6,1)=Energy(6,1)+1;
    end;
    if Data_1(i,18)==7;
        Energy(7,1)=Energy(7,1)+1;
    end;
    if Data_1(i,18)==8;
        Energy(8,1)=Energy(8,1)+1;
    end;
    if Data_1(i,18)==9;
        Energy(9,1)=Energy(9,1)+1;
    end;
    if Data_1(i,18)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
end;

EnergyU=zeros(10,1);
for i=1:n_1urb;
    if Data_1urb(i,18)==1;
        EnergyU(1,1)=EnergyU(1,1)+1;
    end;
    if Data_1urb(i,18)==2;
        EnergyU(2,1)=EnergyU(2,1)+1;
    end;
    if Data_1urb(i,18)==3;
        EnergyU(3,1)=EnergyU(3,1)+1;
    end;
    if Data_1urb(i,18)==4;
        EnergyU(4,1)=EnergyU(4,1)+1;
    end;
    if Data_1urb(i,18)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if Data_1urb(i,18)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if Data_1urb(i,18)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if Data_1urb(i,18)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if Data_1urb(i,18)==9;
```

```
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if Data_1urb(i,18)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;

EnergyR=zeros(10,1);
for i=1:n_1rur;
    if Data_1rur(i,18)==1;
        EnergyR(1,1)=EnergyR(1,1)+1;
    end;
    if Data_1rur(i,18)==2;
        EnergyR(2,1)=EnergyR(2,1)+1;
    end;
    if Data_1rur(i,18)==3;
        EnergyR(3,1)=EnergyR(3,1)+1;
    end;
    if Data_1rur(i,18)==4;
        EnergyR(4,1)=EnergyR(4,1)+1;
    end;
    if Data_1rur(i,18)==5;
        EnergyR(5,1)=EnergyR(5,1)+1;
    end;
    if Data_1rur(i,18)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if Data_1rur(i,18)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if Data_1rur(i,18)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if Data_1rur(i,18)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if Data_1rur(i,18)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/n_1rur;
EnergyU=EnergyU/n_1urb;
Energy=Energy/n_1;

EnergyT2_1=[EnergyR EnergyU Energy];

Energy=zeros(10,1);
for i=1:n_2;
    if Data_2(i,18)==1;
        Energy(1,1)=Energy(1,1)+1;
```

```
    end;
    if Data_2(i,18)==2;
        Energy(2,1)=Energy(2,1)+1;
    end;
    if Data_2(i,18)==3;
        Energy(3,1)=Energy(3,1)+1;
    end;
    if Data_2(i,18)==4;
        Energy(4,1)=Energy(4,1)+1;
    end;
    if Data_2(i,18)==5;
        Energy(5,1)=Energy(5,1)+1;
    end;
    if Data_2(i,18)==6;
        Energy(6,1)=Energy(6,1)+1;
    end;
    if Data_2(i,18)==7;
        Energy(7,1)=Energy(7,1)+1;
    end;
    if Data_2(i,18)==8;
        Energy(8,1)=Energy(8,1)+1;
    end;
    if Data_2(i,18)==9;
        Energy(9,1)=Energy(9,1)+1;
    end;
    if Data_2(i,18)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
end;

EnergyU=zeros(10,1);
for i=1:n_2urb;
    if Data_2urb(i,18)==1;
        EnergyU(1,1)=EnergyU(1,1)+1;
    end;
    if Data_2urb(i,18)==2;
        EnergyU(2,1)=EnergyU(2,1)+1;
    end;
    if Data_2urb(i,18)==3;
        EnergyU(3,1)=EnergyU(3,1)+1;
    end;
    if Data_2urb(i,18)==4;
        EnergyU(4,1)=EnergyU(4,1)+1;
    end;
    if Data_2urb(i,18)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if Data_2urb(i,18)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if Data_2urb(i,18)==7;
```

```
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if Data_2urb(i,18)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if Data_2urb(i,18)==9;
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if Data_2urb(i,18)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;

EnergyR=zeros(10,1);
for i=1:n_2rur;
    if Data_2rur(i,18)==1;
        EnergyR(1,1)=EnergyR(1,1)+1;
    end;
    if Data_2rur(i,18)==2;
        EnergyR(2,1)=EnergyR(2,1)+1;
    end;
    if Data_2rur(i,18)==3;
        EnergyR(3,1)=EnergyR(3,1)+1;
    end;
    if Data_2rur(i,18)==4;
        EnergyR(4,1)=EnergyR(4,1)+1;
    end;
    if Data_2rur(i,18)==5;
        EnergyR(5,1)=EnergyR(5,1)+1;
    end;
    if Data_2rur(i,18)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if Data_2rur(i,18)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if Data_2rur(i,18)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if Data_2rur(i,18)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if Data_2rur(i,18)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/n_2rur;
EnergyU=EnergyU/n_2urb;
Energy=Energy/n_2;
```

```
EnergyT2_2=[EnergyR EnergyU Energy];


Energy=zeros(10,1);
for i=1:n_3;
   if Data_3(i,18)==1;
      Energy(1,1)=Energy(1,1)+1;
   end;
   if Data_3(i,18)==2;
      Energy(2,1)=Energy(2,1)+1;
   end;
   if Data_3(i,18)==3;
      Energy(3,1)=Energy(3,1)+1;
   end;
   if Data_3(i,18)==4;
      Energy(4,1)=Energy(4,1)+1;
   end;
   if Data_3(i,18)==5;
      Energy(5,1)=Energy(5,1)+1;
   end;
   if Data_3(i,18)==6;
      Energy(6,1)=Energy(6,1)+1;
   end;
   if Data_3(i,18)==7;
      Energy(7,1)=Energy(7,1)+1;
   end;
   if Data_3(i,18)==8;
      Energy(8,1)=Energy(8,1)+1;
   end;
   if Data_3(i,18)==9;
      Energy(9,1)=Energy(9,1)+1;
   end;
   if Data_3(i,18)==10;
      Energy(10,1)=Energy(10,1)+1;
   end;
end;

EnergyU=zeros(10,1);
for i=1:n_3urb;
   if Data_3urb(i,18)==1;
      EnergyU(1,1)=EnergyU(1,1)+1;
   end;
   if Data_3urb(i,18)==2;
      EnergyU(2,1)=EnergyU(2,1)+1;
   end;
   if Data_3urb(i,18)==3;
      EnergyU(3,1)=EnergyU(3,1)+1;
   end;
   if Data_3urb(i,18)==4;
      EnergyU(4,1)=EnergyU(4,1)+1;
   end;
```

```
    if Data_3urb(i,18)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if Data_3urb(i,18)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if Data_3urb(i,18)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if Data_3urb(i,18)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if Data_3urb(i,18)==9;
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if Data_3urb(i,18)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;

EnergyR=zeros(10,1);
for i=1:n_3rur;
    if Data_3rur(i,18)==1;
        EnergyR(1,1)=EnergyR(1,1)+1;
    end;
    if Data_3rur(i,18)==2;
        EnergyR(2,1)=EnergyR(2,1)+1;
    end;
    if Data_3rur(i,18)==3;
        EnergyR(3,1)=EnergyR(3,1)+1;
    end;
    if Data_3rur(i,18)==4;
        EnergyR(4,1)=EnergyR(4,1)+1;
    end;
    if Data_3rur(i,18)==5;
        EnergyR(5,1)=EnergyR(5,1)+1;
    end;
    if Data_3rur(i,18)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if Data_3rur(i,18)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if Data_3rur(i,18)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if Data_3rur(i,18)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if Data_3rur(i,18)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
```

```
    end;
end;

EnergyR=EnergyR/n_3rur;
EnergyU=EnergyU/n_3urb;
Energy=Energy/n_3;

EnergyT2_3=[EnergyR EnergyU Energy];


Energy=zeros(10,1);
for i=1:n_4;
    if Data_4(i,18)==1;
        Energy(1,1)=Energy(1,1)+1;
    end;
    if Data_4(i,18)==2;
        Energy(2,1)=Energy(2,1)+1;
    end;
    if Data_4(i,18)==3;
        Energy(3,1)=Energy(3,1)+1;
    end;
    if Data_4(i,18)==4;
        Energy(4,1)=Energy(4,1)+1;
    end;
    if Data_4(i,18)==5;
        Energy(5,1)=Energy(5,1)+1;
    end;
    if Data_4(i,18)==6;
        Energy(6,1)=Energy(6,1)+1;
    end;
    if Data_4(i,18)==7;
        Energy(7,1)=Energy(7,1)+1;
    end;
    if Data_4(i,18)==8;
        Energy(8,1)=Energy(8,1)+1;
    end;
    if Data_4(i,18)==9;
        Energy(9,1)=Energy(9,1)+1;
    end;
    if Data_4(i,18)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
end;

EnergyU=zeros(10,1);
for i=1:n_4urb;
    if Data_4urb(i,18)==1;
        EnergyU(1,1)=EnergyU(1,1)+1;
    end;
    if Data_4urb(i,18)==2;
        EnergyU(2,1)=EnergyU(2,1)+1;
```

```
    end;
    if Data_4urb(i,18)==3;
        EnergyU(3,1)=EnergyU(3,1)+1;
    end;
    if Data_4urb(i,18)==4;
        EnergyU(4,1)=EnergyU(4,1)+1;
    end;
    if Data_4urb(i,18)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if Data_4urb(i,18)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if Data_4urb(i,18)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if Data_4urb(i,18)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if Data_4urb(i,18)==9;
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if Data_4urb(i,18)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;

EnergyR=zeros(10,1);
for i=1:n_4rur;
    if Data_4rur(i,18)==1;
        EnergyR(1,1)=EnergyR(1,1)+1;
    end;
    if Data_4rur(i,18)==2;
        EnergyR(2,1)=EnergyR(2,1)+1;
    end;
    if Data_4rur(i,18)==3;
        EnergyR(3,1)=EnergyR(3,1)+1;
    end;
    if Data_4rur(i,18)==4;
        EnergyR(4,1)=EnergyR(4,1)+1;
    end;
    if Data_4rur(i,18)==5;
        EnergyR(5,1)=EnergyR(5,1)+1;
    end;
    if Data_4rur(i,18)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if Data_4rur(i,18)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if Data_4rur(i,18)==8;
```

```
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if Data_4rur(i,18)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if Data_4rur(i,18)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/n_4rur;
EnergyU=EnergyU/n_4urb;
Energy=Energy/n_4;

EnergyT2_4=[EnergyR EnergyU Energy];


Energy=zeros(10,1);
for i=1:n_5;
    if Data_5(i,18)==1;
        Energy(1,1)=Energy(1,1)+1;
    end;
    if Data_5(i,18)==2;
        Energy(2,1)=Energy(2,1)+1;
    end;
    if Data_5(i,18)==3;
        Energy(3,1)=Energy(3,1)+1;
    end;
    if Data_5(i,18)==4;
        Energy(4,1)=Energy(4,1)+1;
    end;
    if Data_5(i,18)==5;
        Energy(5,1)=Energy(5,1)+1;
    end;
    if Data_5(i,18)==6;
        Energy(6,1)=Energy(6,1)+1;
    end;
    if Data_5(i,18)==7;
        Energy(7,1)=Energy(7,1)+1;
    end;
    if Data_5(i,18)==8;
        Energy(8,1)=Energy(8,1)+1;
    end;
    if Data_5(i,18)==9;
        Energy(9,1)=Energy(9,1)+1;
    end;
    if Data_5(i,18)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
end;
```

```
EnergyU=zeros(10,1);
for i=1:n_5urb;
   if Data_5urb(i,18)==1;
      EnergyU(1,1)=EnergyU(1,1)+1;
   end;
   if Data_5urb(i,18)==2;
      EnergyU(2,1)=EnergyU(2,1)+1;
   end;
   if Data_5urb(i,18)==3;
      EnergyU(3,1)=EnergyU(3,1)+1;
   end;
   if Data_5urb(i,18)==4;
      EnergyU(4,1)=EnergyU(4,1)+1;
   end;
   if Data_5urb(i,18)==5;
      EnergyU(5,1)=EnergyU(5,1)+1;
   end;
   if Data_5urb(i,18)==6;
      EnergyU(6,1)=EnergyU(6,1)+1;
   end;
   if Data_5urb(i,18)==7;
      EnergyU(7,1)=EnergyU(7,1)+1;
   end;
   if Data_5urb(i,18)==8;
      EnergyU(8,1)=EnergyU(8,1)+1;
   end;
   if Data_5urb(i,18)==9;
      EnergyU(9,1)=EnergyU(9,1)+1;
   end;
   if Data_5urb(i,18)==10;
      EnergyU(10,1)=EnergyU(10,1)+1;
   end;
end;

EnergyR=zeros(10,1);
for i=1:n_5rur;
   if Data_5rur(i,18)==1;
      EnergyR(1,1)=EnergyR(1,1)+1;
   end;
   if Data_5rur(i,18)==2;
      EnergyR(2,1)=EnergyR(2,1)+1;
   end;
   if Data_5rur(i,18)==3;
      EnergyR(3,1)=EnergyR(3,1)+1;
   end;
   if Data_5rur(i,18)==4;
      EnergyR(4,1)=EnergyR(4,1)+1;
   end;
   if Data_5rur(i,18)==5;
      EnergyR(5,1)=EnergyR(5,1)+1;
   end;
```

```
    if Data_5rur(i,18)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if Data_5rur(i,18)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if Data_5rur(i,18)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if Data_5rur(i,18)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if Data_5rur(i,18)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/n_5rur;
EnergyU=EnergyU/n_5urb;
Energy=Energy/n_5;

EnergyT2_5=[EnergyR EnergyU Energy];


Energy=zeros(10,1);
for i=1:n_6;
    if Data_6(i,18)==1;
        Energy(1,1)=Energy(1,1)+1;
    end;
    if Data_6(i,18)==2;
        Energy(2,1)=Energy(2,1)+1;
    end;
    if Data_6(i,18)==3;
        Energy(3,1)=Energy(3,1)+1;
    end;
    if Data_6(i,18)==4;
        Energy(4,1)=Energy(4,1)+1;
    end;
    if Data_6(i,18)==5;
        Energy(5,1)=Energy(5,1)+1;
    end;
    if Data_6(i,18)==6;
        Energy(6,1)=Energy(6,1)+1;
    end;
    if Data_6(i,18)==7;
        Energy(7,1)=Energy(7,1)+1;
    end;
    if Data_6(i,18)==8;
        Energy(8,1)=Energy(8,1)+1;
    end;
    if Data_6(i,18)==9;
```

```
        Energy(9,1)=Energy(9,1)+1;
    end;
    if Data_6(i,18)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
end;

EnergyU=zeros(10,1);
for i=1:n_6urb;
    if Data_6urb(i,18)==1;
        EnergyU(1,1)=EnergyU(1,1)+1;
    end;
    if Data_6urb(i,18)==2;
        EnergyU(2,1)=EnergyU(2,1)+1;
    end;
    if Data_6urb(i,18)==3;
        EnergyU(3,1)=EnergyU(3,1)+1;
    end;
    if Data_6urb(i,18)==4;
        EnergyU(4,1)=EnergyU(4,1)+1;
    end;
    if Data_6urb(i,18)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if Data_6urb(i,18)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if Data_6urb(i,18)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if Data_6urb(i,18)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if Data_6urb(i,18)==9;
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if Data_6urb(i,18)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;

EnergyR=zeros(10,1);
for i=1:n_6rur;
    if Data_6rur(i,18)==1;
        EnergyR(1,1)=EnergyR(1,1)+1;
    end;
    if Data_6rur(i,18)==2;
        EnergyR(2,1)=EnergyR(2,1)+1;
    end;
    if Data_6rur(i,18)==3;
        EnergyR(3,1)=EnergyR(3,1)+1;
```

```
    end;
    if Data_6rur(i,18)==4;
        EnergyR(4,1)=EnergyR(4,1)+1;
    end;
    if Data_6rur(i,18)==5;
        EnergyR(5,1)=EnergyR(5,1)+1;
    end;
    if Data_6rur(i,18)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if Data_6rur(i,18)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if Data_6rur(i,18)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if Data_6rur(i,18)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if Data_6rur(i,18)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/n_6rur;
EnergyU=EnergyU/n_6urb;
Energy=Energy/n_6;

EnergyT2_6=[EnergyR EnergyU Energy];

Energy=zeros(10,1);
for i=1:n_7;
    if Data_7(i,18)==1;
        Energy(1,1)=Energy(1,1)+1;
    end;
    if Data_7(i,18)==2;
        Energy(2,1)=Energy(2,1)+1;
    end;
    if Data_7(i,18)==3;
        Energy(3,1)=Energy(3,1)+1;
    end;
    if Data_7(i,18)==4;
        Energy(4,1)=Energy(4,1)+1;
    end;
    if Data_7(i,18)==5;
        Energy(5,1)=Energy(5,1)+1;
    end;
    if Data_7(i,18)==6;
        Energy(6,1)=Energy(6,1)+1;
    end;
    if Data_7(i,18)==7;
```

```
        Energy(7,1)=Energy(7,1)+1;
    end;
    if Data_7(i,18)==8;
        Energy(8,1)=Energy(8,1)+1;
    end;
    if Data_7(i,18)==9;
        Energy(9,1)=Energy(9,1)+1;
    end;
    if Data_7(i,18)==10;
        Energy(10,1)=Energy(10,1)+1;
    end;
end;

EnergyU=zeros(10,1);
for i=1:n_7urb;
    if Data_7urb(i,18)==1;
        EnergyU(1,1)=EnergyU(1,1)+1;
    end;
    if Data_7urb(i,18)==2;
        EnergyU(2,1)=EnergyU(2,1)+1;
    end;
    if Data_7urb(i,18)==3;
        EnergyU(3,1)=EnergyU(3,1)+1;
    end;
    if Data_7urb(i,18)==4;
        EnergyU(4,1)=EnergyU(4,1)+1;
    end;
    if Data_7urb(i,18)==5;
        EnergyU(5,1)=EnergyU(5,1)+1;
    end;
    if Data_7urb(i,18)==6;
        EnergyU(6,1)=EnergyU(6,1)+1;
    end;
    if Data_7urb(i,18)==7;
        EnergyU(7,1)=EnergyU(7,1)+1;
    end;
    if Data_7urb(i,18)==8;
        EnergyU(8,1)=EnergyU(8,1)+1;
    end;
    if Data_7urb(i,18)==9;
        EnergyU(9,1)=EnergyU(9,1)+1;
    end;
    if Data_7urb(i,18)==10;
        EnergyU(10,1)=EnergyU(10,1)+1;
    end;
end;

EnergyR=zeros(10,1);
for i=1:n_7rur;
    if Data_7rur(i,18)==1;
        EnergyR(1,1)=EnergyR(1,1)+1;
```

```
    end;
    if Data_7rur(i,18)==2;
        EnergyR(2,1)=EnergyR(2,1)+1;
    end;
    if Data_7rur(i,18)==3;
        EnergyR(3,1)=EnergyR(3,1)+1;
    end;
    if Data_7rur(i,18)==4;
        EnergyR(4,1)=EnergyR(4,1)+1;
    end;
    if Data_7rur(i,18)==5;
        EnergyR(5,1)=EnergyR(5,1)+1;
    end;
    if Data_7rur(i,18)==6;
        EnergyR(6,1)=EnergyR(6,1)+1;
    end;
    if Data_7rur(i,18)==7;
        EnergyR(7,1)=EnergyR(7,1)+1;
    end;
    if Data_7rur(i,18)==8;
        EnergyR(8,1)=EnergyR(8,1)+1;
    end;
    if Data_7rur(i,18)==9;
        EnergyR(9,1)=EnergyR(9,1)+1;
    end;
    if Data_7rur(i,18)==10;
        EnergyR(10,1)=EnergyR(10,1)+1;
    end;
end;

EnergyR=EnergyR/n_7rur;
EnergyU=EnergyU/n_7urb;
Energy=Energy/n_7;

EnergyT2_7=[EnergyR EnergyU Energy];

.
```

Annex 6: LPG Demand for Provinces

Household demand of LPG (Kg/Month)

Concept	Rural	Urban	Total
Total			
Mean	1.94	9.29	3.34
Standard Deviation	3.77	7.53	5.57
Max.	117.79	135.47	135.47
Min.	-	-	-

Source: NRVA Survey 2007

Elaboration: Own

Household demand of LPG Balk (Kg/Month) 1

Concept	Rural	Urban	Total
Total			
Mean	0.42	5.21	2.00
Standard Deviation	1.46	4.49	3.63
Max.	11.05	28.41	28.41
Min.	-	-	-

Source: NRVA Survey 2007

Elaboration: Own

Household demand of LPG Jawzjan (Kg/Month) 2

Concept	Rural	Urban	Total
Total			
Mean	1.36	6.14	2.28
Standard Deviation	3.62	5.44	4.45
Max.	32.19	31.39	32.19
Min.	-	-	-

Source: NRVA Survey 2007

Elaboration: Own

Household demand of LPG Samangan (Kg/Month) 3

Concept	Rural	Urban	Total
Total			
Mean	0.88	-	0.88
Standard Deviation	2.47	-	2.47
Max.	23.47	-	23.47
Min.	-	-	-

Source: NRVA Survey 2007

Elaboration: Own

Household demand of LPG Baghln (Kg/Month) 4

Concept	Rural	Urban	Total
Total			
Mean	1.52	5.65	2.21
Standard Deviation	2.91	5.94	3.94
Max.	16.45	28.79	28.79
Min.	-	-	-

Source: NRVA Survey 2007

Elaboration: Own

Household demand of LPG Kunduz (Kg/Month) 5

Concept	Rural	Urban	Total
Total			
Mean	0.98	5.63	1.99
Standard Deviation	2.23	6.14	4.12
Max.	17.02	30.94	30.94
Min.	-	-	-

Source: NRVA Survey 2007

Elaboration: Own

Household demand of LPG Parwan (Kg/Month) 6

Concept	Rural	Urban	Total
Total			
Mean	4.25	-	4.23
Standard Deviation	4.28	-	4.53
Max.	31.27	-	31.27
Min.	-	-	-

Source: NRVA Survey 2007

Elaboration: Own

Household demand of LPG Kabul (Kg/Month) 7

Concept	Rural	Urban	Total
Total			
Mean	5.52	11.08	10.04
Standard Deviation	6.47	7.54	7.67
Max.	67.73	135.47	135.47
Min.	-	-	-

Source: NRVA Survey 2007

Elaboration: Own

.

Annex 7: Residential Information for Provinces

NG Demand for Residential Use (MM CF)												
Province (Urban)	**Unit**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Balk (Mazar-e-Sharif)	MM CF	-	2.9	3.9	5.3	7.1	9.5	12.8	17.1	22.9	30.7	41.2
Jawzjan (Sheberghan)	MM CF	-	3.5	3.9	4.3	4.8	5.4	6.1	6.8	7.6	8.5	9.5
Samangan	MM CF	-	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.1	0.1
Baghlan	MM CF	-	3.2	3.8	4.6	5.5	6.6	7.9	9.5	11.4	13.6	16.4
Kunduz	MM CF	-	3.2	3.9	4.8	5.9	7.3	9.0	11.1	13.7	16.9	20.8
Parwan	MM CF	-	2.4	2.2	2.0	1.8	1.6	1.5	1.4	1.2	1.1	1.0
Kabul	MM CF	-	6.2	10.2	16.7	27.4	44.8	73.3	119.9	196.1	320.9	525.0
Total		**-**	21.9	28.4	38.1	52.9	75.5	110.7	165.9	253.1	391.9	614.0

NG Demand for Residential Use (MM CFD)												
Province (Urban)	**Unit**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Balk (Mazar-e-Sharif)	MM CFD	-	0.01	0.01	0.01	0.02	0.03	0.03	0.05	0.06	0.08	0.11
Jawzjan (Sheberghan)	MM CFD	-	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03
Samangan	MM CFD	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Baghlan	MM CFD	-	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04
Kunduz	MM CFD	-	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.04	0.05	0.06
Parwan	MM CFD	-	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Kabul	MM CFD	-	0.02	0.03	0.05	0.07	0.12	0.20	0.33	0.54	0.88	1.44
Total	**MM CFD**	**-**	**0.06**	**0.08**	**0.10**	**0.14**	**0.21**	**0.30**	**0.45**	**0.69**	**1.07**	**1.68**

Province (Urban)	**Unit**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Low Case	MM CFD	-	0.02	0.02	0.03	0.03	0.04	0.05	0.07	0.08	0.11	0.14
Case 1	MM CFD	-	0.06	0.08	0.10	0.14	0.21	0.30	0.45	0.69	1.07	1.68
Case 2	MM CFD	-	0.06	0.08	0.10	0.14	0.21	0.30	0.45	0.69	1.07	1.68

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Annex 8: Volumes Considered for LDC in Each Region

Volumes: Balk (Mazar e Sharif)												
Sector	**Unit**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Ind. & Com.	MM CF	-	1,326.0	2,040.2	2,787.1	3,567.9	4,383.7	5,235.7	6,125.2	7,053.4	7,224.0	7,398.7
Residential	MM CF	-	2.9	3.9	5.3	7.1	9.5	12.8	17.1	22.9	30.7	41.2
CNG	MM CF	-	37.5	76.8	118.0	161.0	205.9	252.9	301.9	353.1	406.5	462.2
Total	**MM CF**	**-**	**1,366.5**	**2,121.0**	**2,910.4**	**3,736.0**	**4,599.1**	**5,501.3**	**6,444.2**	**7,429.4**	**7,661.3**	**7,902.1**
Ind. & Com.	MM CM	-	37.5	57.7	78.8	100.9	123.9	148.0	173.1	199.4	204.2	209.2
Residential	MM CM	-	0.1	0.1	0.1	0.2	0.3	0.4	0.5	0.6	0.9	1.2
CNG	MM CM	-	1.1	2.2	3.3	4.6	5.8	7.1	8.5	10.0	11.5	13.1
Total	**MM CM**	**-**	**38.6**	**60.0**	**82.3**	**105.6**	**130.0**	**155.5**	**182.2**	**210.0**	**216.6**	**223.4**
Ind. & Com.	M CM	-	37,483.3	57,673.6	78,788.2	100,859.5	123,920.5	148,005.6	173,150.0	199,390.1	204,212.1	209,150.7
Residential	M CM	-	83.1	111.5	149.5	200.4	268.8	360.4	483.4	648.2	869.2	1,165.6
CNG	M CM	-	1,061.4	2,172.0	3,334.5	4,550.4	5,821.0	7,147.8	8,534.9	9,981.0	11,491.7	13,065.6
Total	**M CM**	**-**	**38,627.9**	**59,957.0**	**82,272.2**	**105,610.3**	**130,010.3**	**155,513.8**	**182,168.2**	**210,019.3**	**216,573.1**	**223,381.9**
Ind. & Com.	BCM	-	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
Residential	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**BCM**	**-**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**
Ind. & Com.	MM CFD	-	3.6	5.6	7.6	9.8	12.0	14.3	16.8	19.3	19.8	20.3
Residential	MM CFD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
CNG	MM CFD	-	0.1	0.2	0.3	0.4	0.6	0.7	0.8	1.0	1.1	1.3
Total	**MM CFD**	**-**	**3.7**	**5.8**	**8.0**	**10.2**	**12.6**	**15.1**	**17.7**	**20.4**	**21.0**	**21.6**
Ind. & Com.	MM CMD	-	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.6
Residential	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**MM CMD**	**-**	**0.1**	**0.2**	**0.2**	**0.3**	**0.4**	**0.4**	**0.5**	**0.6**	**0.6**	**0.6**
Ind. & Com.	M CMD	-	102.7	158.0	215.9	276.3	339.5	405.5	474.4	546.3	559.5	573.0
Residential	M CMD	-	0.2	0.3	0.4	0.5	0.7	1.0	1.3	1.8	2.4	3.2
CNG	M CMD	-	2.9	6.0	9.1	12.5	15.9	19.6	23.4	27.3	31.5	35.8
Total	**M CMD**	**-**	**105.8**	**164.3**	**225.4**	**289.3**	**356.2**	**426.1**	**499.1**	**575.4**	**593.4**	**612.0**

Volumes: Jawzjan (Sheberghan)												
Sector	**Unit**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Ind. & Com.	MM CF	-	288.1	441.4	600.5	765.6	936.8	1,114.3	1,298.2	1,488.8	1,518.5	1,548.9
Residential	MM CF	-	3.5	3.9	4.3	4.8	5.4	6.1	6.8	7.6	8.5	9.5
CNG	MM CF	-	2.1	4.2	6.5	8.8	11.3	13.9	16.6	19.4	22.3	25.4
Total	**MM CF**	**-**	**293.6**	**449.5**	**611.4**	**779.3**	**953.5**	**1,134.2**	**1,321.6**	**1,515.8**	**1,549.4**	**1,583.8**
Ind. & Com.	MM CM	-	8.1	12.5	17.0	21.6	26.5	31.5	36.7	42.1	42.9	43.8
Residential	MM CM	-	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3
CNG	MM CM	-	0.1	0.1	0.2	0.2	0.3	0.4	0.5	0.5	0.6	0.7
Total	**MM CM**	**-**	**8.3**	**12.7**	**17.3**	**22.0**	**27.0**	**32.1**	**37.4**	**42.8**	**43.8**	**44.8**
Ind. & Com.	M CM	-	8,143.1	12,477.8	16,975.9	21,642.2	26,481.4	31,498.4	36,698.4	42,086.4	42,927.2	43,784.7
Residential	M CM	-	97.9	109.5	122.4	137.0	153.2	171.3	191.6	214.4	239.8	268.2
CNG	M CM	-	59.0	119.3	183.9	249.9	320.1	393.1	468.9	549.0	631.8	718.8
Total	**M CM**	**-**	**8,299.9**	**12,706.6**	**17,282.3**	**22,029.1**	**26,954.7**	**32,062.9**	**37,359.0**	**42,849.7**	**43,798.7**	**44,771.8**
Ind. & Com.	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Residential	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**BCM**	**-**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Ind. & Com.	MM CFD	-	0.8	1.2	1.6	2.1	2.6	3.1	3.6	4.1	4.2	4.2
Residential	MM CFD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CFD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Total	**MM CFD**	**-**	**0.8**	**1.2**	**1.7**	**2.1**	**2.6**	**3.1**	**3.6**	**4.2**	**4.2**	**4.3**
Ind. & Com.	MM CMD	-	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Residential	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**MM CMD**	**-**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**
Ind. & Com.	M CMD	-	22.3	34.2	46.5	59.3	72.6	86.3	100.5	115.3	117.6	120.0
Residential	M CMD	-	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.7	0.7
CNG	M CMD	-	0.2	0.3	0.5	0.7	0.9	1.1	1.3	1.5	1.7	2.0
Total	**M CMD**	**-**	**22.7**	**34.8**	**47.3**	**60.4**	**73.8**	**87.8**	**102.4**	**117.4**	**120.0**	**122.7**

Volumes: Samangan												
Sector	**Unit**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Ind. & Com.	MM CF	-	71.8	107.9	144.0	180.2	216.3	252.4	288.5	324.7	324.9	325.2
Residential	MM CF	-	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.1	0.1
CNG	MM CF	-	0.4	0.8	1.1	1.5	1.9	2.3	2.7	3.1	3.5	3.9
Total	**MM CF**	**-**	**72.7**	**109.1**	**145.5**	**182.0**	**218.5**	**255.0**	**291.4**	**327.9**	**328.5**	**329.2**
Ind. & Com.	MM CM	-	2.0	3.1	4.1	5.1	6.1	7.1	8.2	9.2	9.2	9.2
Residential	MM CM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CM	-	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1
Total	**MM CM**	**-**	**2.1**	**3.1**	**4.1**	**5.1**	**6.2**	**7.2**	**8.2**	**9.3**	**9.3**	**9.3**
Ind. & Com.	M CM	-	2,028.7	3,050.0	4,071.4	5,092.7	6,114.1	7,135.4	8,156.8	9,178.1	9,185.2	9,192.2
Residential	M CM	-	14.1	11.9	10.1	8.6	7.3	6.2	5.3	4.5	3.8	3.2
CNG	M CM	-	11.2	22.5	32.3	43.5	54.8	66.0	75.8	87.0	98.3	109.5
Total	**M CM**	**-**	**2,054.0**	**3,084.4**	**4,113.8**	**5,144.9**	**6,176.2**	**7,207.6**	**8,237.9**	**9,269.7**	**9,287.2**	**9,304.9**
Ind. & Com.	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Residential	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**BCM**	**-**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Ind. & Com.	MM CFD	-	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.9	0.9
Residential	MM CFD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CFD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**MM CFD**	**-**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**0.9**	**0.9**
Ind. & Com.	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Residential	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**MM CMD**	**-**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Ind. & Com.	M CMD	-	5.6	8.4	11.2	14.0	16.8	19.5	22.3	25.1	25.2	25.2
Residential	M CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	M CMD	-	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3
Total	**M CMD**	**-**	**5.6**	**8.5**	**11.3**	**14.1**	**16.9**	**19.7**	**22.6**	**25.4**	**25.4**	**25.5**

Volumes: Baghlan												
Sector	**Unit**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Ind. & Com.	MM CF	-	385.0	589.5	801.3	1,020.7	1,247.8	1,482.9	1,726.1	1,977.8	2,015.5	2,054.0
Residential	MM CF	-	3.2	3.8	4.6	5.5	6.6	7.9	9.5	11.4	13.6	16.4
CNG	MM CF	-	7.9	16.1	24.5	33.3	42.4	51.9	61.6	71.7	82.1	92.9
Total	**MM CF**	**-**	**396.1**	**609.4**	**830.4**	**1,059.5**	**1,296.8**	**1,542.6**	**1,797.2**	**2,060.9**	**2,111.3**	**2,163.2**
Ind. & Com.	MM CM	-	10.9	16.7	22.7	28.9	35.3	41.9	48.8	55.9	57.0	58.1
Residential	MM CM	-	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.5
CNG	MM CM	-	0.2	0.5	0.7	0.9	1.2	1.5	1.7	2.0	2.3	2.6
Total	**MM CM**	**-**	**11.2**	**17.2**	**23.5**	**29.9**	**36.7**	**43.6**	**50.8**	**58.3**	**59.7**	**61.2**
Ind. & Com.	M CM	-	10,884.7	16,664.2	22,651.5	28,852.4	35,272.7	41,918.2	48,795.2	55,909.9	56,976.6	58,063.5
Residential	M CM	-	90.1	108.1	129.6	155.4	186.4	223.6	268.2	321.6	385.8	462.7
CNG	M CM	-	223.2	454.9	693.6	942.1	1,199.0	1,465.8	1,741.0	2,026.0	2,320.8	2,625.5
Total	**M CM**	**-**	**11,198.0**	**17,227.1**	**23,474.7**	**29,949.9**	**36,658.1**	**43,607.6**	**50,804.4**	**58,257.5**	**59,683.1**	**61,151.7**
Ind. & Com.	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Residential	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**BCM**	**-**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**
Ind. & Com.	MM CFD	-	1.1	1.6	2.2	2.8	3.4	4.1	4.7	5.4	5.5	5.6
Residential	MM CFD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CFD	-	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3
Total	**MM CFD**	**-**	**1.1**	**1.7**	**2.3**	**2.9**	**3.6**	**4.2**	**4.9**	**5.6**	**5.8**	**5.9**
Ind. & Com.	MM CMD	-	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
Residential	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**MM CMD**	**-**	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.2**	**0.2**	**0.2**
Ind. & Com.	M CMD	-	29.8	45.7	62.1	79.0	96.6	114.8	133.7	153.2	156.1	159.1
Residential	M CMD	-	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.9	1.1	1.3
CNG	M CMD	-	0.6	1.2	1.9	2.6	3.3	4.0	4.8	5.6	6.4	7.2
Total	**M CMD**	**-**	**30.7**	**47.2**	**64.3**	**82.1**	**100.4**	**119.5**	**139.2**	**159.6**	**163.5**	**167.5**

Volumes: Kunduz												
Sector	**Unit**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Ind. & Com.	MM CF	-	505.8	777.1	1,060.2	1,355.4	1,663.0	1,983.5	2,317.2	2,664.8	2,725.5	2,787.6
Residential	MM CF	-	3.2	3.9	4.8	5.9	7.3	9.0	11.1	13.7	16.9	20.8
CNG	MM CF	-	11.5	23.5	36.0	49.1	62.7	76.9	91.6	107.1	123.1	139.8
Total	**MM CF**	**-**	**520.4**	**804.6**	**1,101.0**	**1,410.4**	**1,733.0**	**2,069.4**	**2,420.0**	**2,785.5**	**2,865.4**	**2,948.1**
Ind. & Com.	MM CM	-	14.3	22.0	30.0	38.3	47.0	56.1	65.5	75.3	77.0	78.8
Residential	MM CM	-	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.6
CNG	MM CM	-	0.3	0.7	1.0	1.4	1.8	2.2	2.6	3.0	3.5	4.0
Total	**MM CM**	**-**	**14.7**	**22.7**	**31.1**	**39.9**	**49.0**	**58.5**	**68.4**	**78.7**	**81.0**	**83.3**
Ind. & Com.	M CM	-	14,297.6	21,968.8	29,970.6	38,313.8	47,009.6	56,069.5	65,505.3	75,329.1	77,045.1	78,800.3
Residential	M CM	-	89.8	110.6	136.3	167.9	206.9	254.9	314.0	386.9	476.7	587.3
CNG	M CM	-	324.3	664.1	1,017.9	1,387.2	1,771.8	2,173.4	2,590.4	3,027.0	3,479.1	3,950.9
Total	**M CM**	**-**	**14,711.7**	**22,743.5**	**31,124.8**	**39,868.9**	**48,988.3**	**58,497.8**	**68,409.7**	**78,743.0**	**81,000.9**	**83,338.4**
Ind. & Com.	BCM	-	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Residential	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**BCM**	**-**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**
Ind. & Com.	MM CFD	-	1.4	2.1	2.9	3.7	4.6	5.4	6.3	7.3	7.5	7.6
Residential	MM CFD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
CNG	MM CFD	-	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.4
Total	**MM CFD**	**-**	**1.4**	**2.2**	**3.0**	**3.9**	**4.7**	**5.7**	**6.6**	**7.6**	**7.9**	**8.1**
Ind. & Com.	MM CMD	-	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
Residential	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**MM CMD**	**-**	**0.0**	**0.1**	**0.1**	**0.1**	**0.1**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**
Ind. & Com.	M CMD	-	39.2	60.2	82.1	105.0	128.8	153.6	179.5	206.4	211.1	215.9
Residential	M CMD	-	0.2	0.3	0.4	0.5	0.6	0.7	0.9	1.1	1.3	1.6
CNG	M CMD	-	0.9	1.8	2.8	3.8	4.9	6.0	7.1	8.3	9.5	10.8
Total	**M CMD**	**-**	**40.3**	**62.3**	**85.3**	**109.2**	**134.2**	**160.3**	**187.4**	**215.7**	**221.9**	**228.3**

Volumes: Parwan (Charikar)												
Sector	**Unit**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Ind. & Com.	MM CF	-	143.5	215.8	288.1	360.4	432.6	504.9	577.2	649.4	649.9	650.4
Residential	MM CF	-	2.4	2.2	2.0	1.8	1.6	1.5	1.4	1.2	1.1	1.0
CNG	MM CF	-	0.9	1.8	2.8	3.7	4.7	5.6	6.5	7.4	8.3	9.3
Total	**MM CF**	**-**	**146.9**	**219.8**	**292.9**	**365.9**	**438.9**	**512.0**	**585.0**	**658.1**	**659.4**	**660.7**
Ind. & Com.	MM CM	-	4.1	6.1	8.1	10.2	12.2	14.3	16.3	18.4	18.4	18.4
Residential	MM CM	-	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CM	-	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3
Total	**MM CM**	**-**	**4.2**	**6.2**	**8.3**	**10.3**	**12.4**	**14.5**	**16.5**	**18.6**	**18.6**	**18.7**
Ind. & Com.	M CM	-	4,057.9	6,100.8	8,143.8	10,186.8	12,229.8	14,272.7	16,315.7	18,358.7	18,372.7	18,386.7
Residential	M CM	-	67.8	61.7	56.1	51.1	46.5	42.3	38.5	35.0	31.9	29.0
CNG	M CM	-	26.7	51.9	78.6	105.3	132.0	157.2	183.9	210.6	235.9	262.5
Total	**M CM**	**-**	**4,152.3**	**6,214.5**	**8,278.6**	**10,343.2**	**12,408.2**	**14,472.3**	**16,538.1**	**18,604.3**	**18,640.4**	**18,678.3**
Ind. & Com.	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Residential	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**BCM**	**-**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Ind. & Com.	MM CFD	-	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	1.8	1.8
Residential	MM CFD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CFD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**MM CFD**	**-**	**0.4**	**0.6**	**0.8**	**1.0**	**1.2**	**1.4**	**1.6**	**1.8**	**1.8**	**1.8**
Ind. & Com.	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Residential	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**MM CMD**	**-**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**
Ind. & Com.	M CMD	-	11.1	16.7	22.3	27.9	33.5	39.1	44.7	50.3	50.3	50.4
Residential	M CMD	-	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
CNG	M CMD	-	0.1	0.1	0.2	0.3	0.4	0.4	0.5	0.6	0.6	0.7
Total	**M CMD**	**-**	**11.4**	**17.0**	**22.7**	**28.3**	**34.0**	**39.7**	**45.3**	**51.0**	**51.1**	**51.2**

Volumes: Kabul												
Sector	**Unit**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Ind. & Com.	MM CF	-	8,696.2	13,471.9	18,529.8	23,882.9	29,544.2	35,527.8	41,847.8	48,519.2	50,032.4	51,592.7
Residential	MM CF	-	6.2	10.2	16.7	27.4	44.8	73.3	119.9	196.1	320.9	525.0
CNG	MM CF	-	256.0	527.5	815.2	1,120.0	1,442.5	1,783.5	2,144.0	2,524.6	2,926.5	3,350.4
Total	**MM CF**	**-**	**8,958.5**	**14,009.5**	**19,361.8**	**25,030.2**	**31,031.5**	**37,384.5**	**44,111.6**	**51,240.0**	**53,279.8**	**55,468.1**
Ind. & Com.	MM CM	-	245.8	380.8	523.8	675.1	835.2	1,004.3	1,183.0	1,371.6	1,414.3	1,458.5
Residential	MM CM	-	0.2	0.3	0.5	0.8	1.3	2.1	3.4	5.5	9.1	14.8
CNG	MM CM	-	7.2	14.9	23.0	31.7	40.8	50.4	60.6	71.4	82.7	94.7
Total	**MM CM**	**-**	**253.2**	**396.0**	**547.3**	**707.6**	**877.2**	**1,056.8**	**1,247.0**	**1,448.5**	**1,506.1**	**1,568.0**
Ind. & Com.	M CM	-	245,829.7	380,830.1	523,811.4	675,134.0	835,172.9	1,004,318.3	1,182,975.9	1,371,567.7	1,414,343.3	1,458,452.2
Residential	M CM	-	176.6	289.0	472.9	773.6	1,265.8	2,071.0	3,388.3	5,543.7	9,070.2	14,840.0
CNG	M CM	-	7,236.2	14,910.5	23,045.3	31,660.2	40,777.8	50,417.6	60,607.9	71,368.1	82,727.9	94,709.6
Total	**M CM**	**-**	**253,242.5**	**396,029.6**	**547,329.5**	**707,567.9**	**877,216.5**	**1,056,806.9**	**1,246,972.1**	**1,448,479.5**	**1,506,141.4**	**1,568,001.8**
Ind. & Com.	BCM	-	0.2	0.4	0.5	0.7	0.8	1.0	1.2	1.4	1.4	1.5
Residential	BCM	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	BCM	-	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Total	**BCM**	**-**	**0.3**	**0.4**	**0.5**	**0.7**	**0.9**	**1.1**	**1.2**	**1.4**	**1.5**	**1.6**
Ind. & Com.	MM CFD	-	23.8	36.9	50.8	65.4	80.9	97.3	114.7	132.9	137.1	141.3
Residential	MM CFD	-	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.5	0.9	1.4
CNG	MM CFD	-	0.7	1.4	2.2	3.1	4.0	4.9	5.9	6.9	8.0	9.2
Total	**MM CFD**	**-**	**24.5**	**38.4**	**53.0**	**68.6**	**85.0**	**102.4**	**120.9**	**140.4**	**146.0**	**152.0**
Ind. & Com.	MM CMD	-	0.7	1.0	1.4	1.8	2.3	2.8	3.2	3.8	3.9	4.0
Residential	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CNG	MM CMD	-	0.0	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3
Total	**MM CMD**	**-**	**0.7**	**1.1**	**1.5**	**1.9**	**2.4**	**2.9**	**3.4**	**4.0**	**4.1**	**4.3**
Ind. & Com.	M CMD	-	673.5	1,043.4	1,435.1	1,849.7	2,288.1	2,751.6	3,241.0	3,757.7	3,874.9	3,995.8
Residential	M CMD	-	0.5	0.8	1.3	2.1	3.5	5.7	9.3	15.2	24.8	40.7
CNG	M CMD	-	19.8	40.9	63.1	86.7	111.7	138.1	166.0	195.5	226.7	259.5
Total	**M CMD**	**-**	**693.8**	**1,085.0**	**1,499.5**	**1,938.5**	**2,403.3**	**2,895.4**	**3,416.4**	**3,968.4**	**4,126.4**	**4,295.9**

.

Annex 9: Total Volumes Low Case

Volumes - Low Case

Concept	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Balk (Mazar-e-Sharif)												
Ind.&Com.	MM CFD	-	3.63	5.59	7.64	9.78	12.01	14.34	16.78	19.32	19.79	20.27
Residential	MM CFD	-	0.01	0.01	0.01	0.02	0.03	0.03	0.05	0.06	0.08	0.11
CNG	MM CFD	-	0.10	0.21	0.32	0.44	0.56	0.69	0.83	0.97	1.11	1.27
Fertilizer Plant	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Power Gen.	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Total	MM CFD	-	3.74	5.81	7.97	10.24	12.60	15.07	17.66	20.35	20.99	21.65
Jawzjan (Sheberghan)												
Ind.&Com.	MM CFD	-	0.79	1.21	1.65	2.10	2.57	3.05	3.56	4.08	4.16	4.24
Residential	MM CFD	-	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03
CNG	MM CFD	-	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.05	0.06	0.07
Fertilizer Plant	MM CFD	-	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51
Power Gen.	MM CFD	-	21.07	31.60	42.14	42.14	42.14	42.14	42.14	42.14	42.14	42.14
Total	MM CFD	-	28.39	39.35	50.33	50.79	51.26	51.76	52.27	52.80	52.90	52.99
Total MM CFD												
Ind.&Com.	MM CFD	-	4.42	6.80	9.28	11.87	14.58	17.40	20.34	23.40	23.95	24.51
Residential	MM CFD	-	0.02	0.02	0.03	0.03	0.04	0.05	0.07	0.08	0.11	0.14
CNG	MM CFD	-	0.11	0.22	0.34	0.47	0.60	0.73	0.87	1.02	1.17	1.34
Fertilizer Plant	MM CFD	-	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51
Power Gen.	MM CFD	-	21.07	31.60	42.14	42.14	42.14	42.14	42.14	42.14	42.14	42.14
Total	**MM CFD**	**-**	**32.1**	**45.2**	**58.3**	**61.0**	**63.9**	**66.8**	**69.9**	**73.2**	**73.9**	**74.6**
Total MM CMD												
Ind.&Com.	MM CMD	-	0.13	0.19	0.26	0.34	0.41	0.49	0.57	0.66	0.68	0.69
Residential	MM CMD	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CNG	MM CMD	-	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04
Fertilizer Plant	MM CMD	-	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Power Gen.	MM CMD	-	0.60	0.89	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19
Total	**MM CMD**	**-**	**0.9**	**1.3**	**1.6**	**1.7**	**1.8**	**1.9**	**2.0**	**2.1**	**2.1**	**2.1**
Cumulative	**BCM**	**-**	**0.3**	**0.8**	**1.4**	**2.0**	**2.7**	**3.4**	**4.1**	**4.9**	**5.6**	**6.4**

Volumes per Province

Province	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Balk (Mazar-e-Sharif)	MM CFD	-	3.7	5.8	8.0	10.2	12.6	15.1	17.7	20.4	21.0	21.6
Jawzjan (Sheberghan)	MM CFD	-	28.4	39.3	50.3	50.8	51.3	51.8	52.3	52.8	52.9	53.0
Samangan	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Baghlan	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Kunduz	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Parwan	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Kabul	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Total	**MM CFD**	**-**	**32.1**	**45.2**	**58.3**	**61.0**	**63.9**	**66.8**	**69.9**	**73.2**	**73.9**	**74.6**
Balk (Mazar-e-Sharif)	MM CMD	-	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.6	0.6	0.6
Jawzjan (Sheberghan)	MM CMD	-	0.8	1.1	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.5
Samangan	MM CMD	-	-	-	-	-	-	-	-	-	-	-
Baghlan	MM CMD	-	-	-	-	-	-	-	-	-	-	-
Kunduz	MM CMD	-	-	-	-	-	-	-	-	-	-	-
Parwan	MM CMD	-	-	-	-	-	-	-	-	-	-	-
Kabul	MM CMD	-	-	-	-	-	-	-	-	-	-	-
Total	**MM CMD**	**-**	**0.9**	**1.3**	**1.6**	**1.7**	**1.8**	**1.9**	**2.0**	**2.1**	**2.1**	**2.1**

.

Annex 10: Total Volumes Case 1

Concept	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Balk (Mazar-e-Sharif)												
Ind.&Com.	MM CFD	-	3.63	5.59	7.64	9.78	12.01	14.34	16.78	19.32	19.79	20.27
Residential	MM CFD	-	0.01	0.01	0.01	0.02	0.03	0.03	0.05	0.06	0.08	0.11
CNG	MM CFD	-	0.10	0.21	0.32	0.44	0.56	0.69	0.83	0.97	1.11	1.27
Fertilizer Plant	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Power Gen.	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Total	MM CFD	-	3.74	5.81	7.97	10.24	12.60	15.07	17.66	20.35	20.99	21.65
Jawzjan (Sheberghan)												
Ind.&Com.	MM CFD	-	0.79	1.21	1.65	2.10	2.57	3.05	3.56	4.08	4.16	4.24
Residential	MM CFD	-	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03
CNG	MM CFD	-	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.05	0.06	0.07
Fertilizer Plant	MM CFD	-	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51
Power Gen.	MM CFD	-	21.07	31.60	42.14	42.14	42.14	42.14	42.14	42.14	42.14	42.14
Total	MM CFD	-	28.39	39.35	50.33	50.79	51.26	51.76	52.27	52.80	52.90	52.99
Samangan												
Ind.&Com.	MM CFD	-	0.20	0.30	0.39	0.49	0.59	0.69	0.79	0.89	0.89	0.89
Residential	MM CFD	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CNG	MM CFD	-	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Fertilizer Plant	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Power Gen.	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Total	MM CFD	-	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	0.90	0.90
Baghlan												
Ind.&Com.	MM CFD	-	1.05	1.62	2.20	2.80	3.42	4.06	4.73	5.42	5.52	5.63
Residential	MM CFD	-	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04
CNG	MM CFD	-	0.02	0.04	0.07	0.09	0.12	0.14	0.17	0.20	0.22	0.25
Fertilizer Plant	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Power Gen.	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Total	MM CFD	-	1.09	1.67	2.28	2.90	3.55	4.23	4.92	5.65	5.78	5.93
Kunduz												
Ind.&Com.	MM CFD	-	1.39	2.13	2.90	3.71	4.56	5.43	6.35	7.30	7.47	7.64
Residential	MM CFD	-	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.04	0.05	0.06
CNG	MM CFD	-	0.03	0.06	0.10	0.13	0.17	0.21	0.25	0.29	0.34	0.38
Fertilizer Plant	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Power Gen.	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Total	MM CFD	-	1.43	2.20	3.02	3.86	4.75	5.67	6.63	7.63	7.85	8.08
Parwan												
Ind.&Com.	MM CFD	-	0.39	0.59	0.79	0.99	1.19	1.38	1.58	1.78	1.78	1.78
Residential	MM CFD	-	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CNG	MM CFD	-	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03
Fertilizer Plant	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Power Gen.	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Total	MM CFD	-	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	1.81	1.81
Kabul												
Ind.&Com.	MM CFD	-	23.83	36.91	50.77	65.43	80.94	97.34	114.65	132.93	137.08	141.35
Residential	MM CFD	-	0.02	0.03	0.05	0.07	0.12	0.20	0.33	0.54	0.88	1.44
CNG	MM CFD	-	0.70	1.45	2.23	3.07	3.95	4.89	5.87	6.92	8.02	9.18
Fertilizer Plant	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Power Gen.	MM CFD	-	21.07	31.60	42.14	42.14	42.14	42.14	42.14	42.14	42.14	42.14
Total	MM CFD	-	45.61	69.99	95.18	110.71	127.16	144.56	162.99	182.52	188.11	194.10
Total MM CFD												
Ind.&Com.	MM CFD	-	31.28	48.34	66.33	85.30	105.27	126.31	148.44	171.72	176.69	181.80
Residential	MM CFD	-	0.06	0.08	0.10	0.14	0.21	0.30	0.45	0.69	1.07	1.68
CNG	MM CFD	-	0.87	1.78	2.75	3.77	4.85	5.99	7.19	8.46	9.79	11.19
Fertilizer Plant	MM CFD	-	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51
Power Gen.	MM CFD	-	42.14	63.21	84.27	84.27	84.27	84.27	84.27	84.27	84.27	84.27
Total	**MM CFD**	**-**	**80.9**	**119.9**	**160.0**	**180.0**	**201.1**	**223.4**	**246.9**	**271.7**	**278.3**	**285.5**
Total MM CMD												
Ind.&Com.	MM CMD	-	0.88	1.37	1.88	2.41	2.98	3.57	4.20	4.85	4.99	5.14
Residential	MM CMD	-	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.05
CNG	MM CMD	-	0.02	0.05	0.08	0.11	0.14	0.17	0.20	0.24	0.28	0.32
Fertilizer Plant	MM CMD	-	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Power Gen.	MM CMD	-	1.19	1.79	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
Total	**MM CMD**	**-**	**2.3**	**3.4**	**4.5**	**5.1**	**5.7**	**6.3**	**7.0**	**7.7**	**7.9**	**8.1**
Cumulative	**BCM**	**-**	**0.8**	**2.1**	**3.7**	**5.6**	**7.7**	**10.0**	**12.5**	**15.3**	**18.2**	**21.1**

Volumes per Province

Province	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Balk (Mazar-e-Sharif)	MM CFD	-	3.7	5.8	8.0	10.2	12.6	15.1	17.7	20.4	21.0	21.6
Jawzjan (Sheberghan)	MM CFD	-	28.4	39.3	50.3	50.8	51.3	51.8	52.3	52.8	52.9	53.0
Samangan	MM CFD	-	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.9	0.9
Baghlan	MM CFD	-	1.1	1.7	2.3	2.9	3.6	4.2	4.9	5.6	5.8	5.9
Kunduz	MM CFD	-	1.4	2.2	3.0	3.9	4.7	5.7	6.6	7.6	7.9	8.1
Parwan	MM CFD	-	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	1.8	1.8
Kabul	MM CFD	-	45.6	70.0	95.2	110.7	127.2	144.6	163.0	182.5	188.1	194.1
Total	**MM CFD**	**-**	**80.9**	**119.9**	**160.0**	**180.0**	**201.1**	**223.4**	**246.9**	**271.7**	**278.3**	**285.5**
Balk (Mazar-e-Sharif)	MM CMD	-	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.6	0.6	0.6
Jawzjan (Sheberghan)	MM CMD	-	0.8	1.1	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.5
Samangan	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Baghlan	MM CMD	-	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
Kunduz	MM CMD	-	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
Parwan	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Kabul	MM CMD	-	1.3	2.0	2.7	3.1	3.6	4.1	4.6	5.2	5.3	5.5
Total	**MM CMD**	**-**	**2.3**	**3.4**	**4.5**	**5.1**	**5.7**	**6.3**	**7.0**	**7.7**	**7.9**	**8.1**

.

Annex 11: Total Volumes Case 2

Concept	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Balk (Mazar-e-Sharif)												
Ind.&Com.	MM CFD	-	3.63	5.59	7.64	9.78	12.01	14.34	16.78	19.32	19.79	20.27
Residential	MM CFD	-	0.01	0.01	0.01	0.02	0.03	0.03	0.05	0.06	0.08	0.11
CNG	MM CFD	-	0.10	0.21	0.32	0.44	0.56	0.69	0.83	0.97	1.11	1.27
Fertilizer Plant	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Power Gen.	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Total	MM CFD	-	3.74	5.81	7.97	10.24	12.60	15.07	17.66	20.35	20.99	21.65
Jawzjan (Sheberghan)												
Ind.&Com.	MM CFD	-	0.79	1.21	1.65	2.10	2.57	3.05	3.56	4.08	4.16	4.24
Residential	MM CFD	-	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03
CNG	MM CFD	-	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.05	0.06	0.07
Fertilizer Plant	MM CFD	-	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51
Power Gen.	MM CFD	-	21.07	31.60	42.14	42.14	42.14	42.14	42.14	42.14	42.14	42.14
Total	MM CFD	-	28.39	39.35	50.33	50.79	51.26	51.76	52.27	52.80	52.90	52.99
Samangan												
Ind.&Com.	MM CFD	-	0.20	0.30	0.39	0.49	0.59	0.69	0.79	0.89	0.89	0.89
Residential	MM CFD	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CNG	MM CFD	-	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Fertilizer Plant	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Power Gen.	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Total	MM CFD	-	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	0.90	0.90
Baghlan												
Ind.&Com.	MM CFD	-	1.05	1.62	2.20	2.80	3.42	4.06	4.73	5.42	5.52	5.63
Residential	MM CFD	-	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04
CNG	MM CFD	-	0.02	0.04	0.07	0.09	0.12	0.14	0.17	0.20	0.22	0.25
Fertilizer Plant	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Power Gen.	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Total	MM CFD	-	1.09	1.67	2.28	2.90	3.55	4.23	4.92	5.65	5.78	5.93
Kunduz												
Ind.&Com.	MM CFD	-	1.39	2.13	2.90	3.71	4.56	5.43	6.35	7.30	7.47	7.64
Residential	MM CFD	-	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.04	0.05	0.06
CNG	MM CFD	-	0.03	0.06	0.10	0.13	0.17	0.21	0.25	0.29	0.34	0.38
Fertilizer Plant	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Power Gen.	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Total	MM CFD	-	1.43	2.20	3.02	3.86	4.75	5.67	6.63	7.63	7.85	8.08
Parwan												
Ind.&Com.	MM CFD	-	0.39	0.59	0.79	0.99	1.19	1.38	1.58	1.78	1.78	1.78
Residential	MM CFD	-	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CNG	MM CFD	-	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03
Fertilizer Plant	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Power Gen.	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Total	MM CFD	-	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	1.81	1.81
Kabul												
Ind.&Com.	MM CFD	-	23.83	36.91	50.77	65.43	80.94	97.34	114.65	132.93	137.08	141.35
Residential	MM CFD	-	0.02	0.03	0.05	0.07	0.12	0.20	0.33	0.54	0.88	1.44
CNG	MM CFD	-	0.70	1.45	2.23	3.07	3.95	4.89	5.87	6.92	8.02	9.18
Fertilizer Plant	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Power Gen.	MM CFD	-	21.07	31.60	42.14	63.21	84.27	84.27	84.27	84.27	84.27	84.27
Total	MM CFD	-	45.61	69.99	95.18	131.78	169.29	186.70	205.13	224.66	230.25	236.24
Total MM CFD												
Ind.&Com.	MM CFD	-	31.28	48.34	66.33	85.30	105.27	126.31	148.44	171.72	176.69	181.80
Residential	MM CFD	-	0.06	0.08	0.10	0.14	0.21	0.30	0.45	0.69	1.07	1.68
CNG	MM CFD	-	0.87	1.78	2.75	3.77	4.85	5.99	7.19	8.46	9.79	11.19
Fertilizer Plant	MM CFD	-	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51
Power Gen.	MM CFD	-	42.14	63.21	84.27	105.34	126.41	126.41	126.41	126.41	126.41	126.41
Total	**MM CFD**	**-**	**80.9**	**119.9**	**160.0**	**201.1**	**243.3**	**265.5**	**289.0**	**313.8**	**320.5**	**327.6**
Total MM CMD												
Ind.&Com.	MM CMD	-	0.88	1.37	1.88	2.41	2.98	3.57	4.20	4.85	4.99	5.14
Residential	MM CMD	-	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.05
CNG	MM CMD	-	0.02	0.05	0.08	0.11	0.14	0.17	0.20	0.24	0.28	0.32
Fertilizer Plant	MM CMD	-	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Power Gen.	MM CMD	-	1.19	1.79	2.38	2.98	3.57	3.57	3.57	3.57	3.57	3.57
Total	**MM CMD**	**-**	**2.3**	**3.4**	**4.5**	**5.7**	**6.9**	**7.5**	**8.2**	**8.9**	**9.1**	**9.3**
Cumulative	**BCM**	**-**	**0.8**	**2.1**	**3.7**	**5.8**	**8.3**	**11.0**	**14.0**	**17.3**	**20.6**	**24.0**

Volumes per Province

Province	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Balk (Mazar-e-Sharif)	MM CFD	-	3.7	5.8	8.0	10.2	12.6	15.1	17.7	20.4	21.0	21.6
Jawzjan (Sheberghan)	MM CFD	-	28.4	39.3	50.3	50.8	51.3	51.8	52.3	52.8	52.9	53.0
Samangan	MM CFD	-	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.9	0.9
Baghlan	MM CFD	-	1.1	1.7	2.3	2.9	3.6	4.2	4.9	5.6	5.8	5.9
Kunduz	MM CFD	-	1.4	2.2	3.0	3.9	4.7	5.7	6.6	7.6	7.9	8.1
Parwan	MM CFD	-	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	1.8	1.8
Kabul	MM CFD	-	45.6	70.0	95.2	131.8	169.3	186.7	205.1	224.7	230.2	236.2
Total	**MM CFD**	**-**	**80.9**	**119.9**	**160.0**	**201.1**	**243.3**	**265.5**	**289.0**	**313.8**	**320.5**	**327.6**
Balk (Mazar-e-Sharif)	MM CMD	-	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.6	0.6	0.6
Jawzjan (Sheberghan)	MM CMD	-	0.8	1.1	1.4	1.4	1.4	1.5	1.5	1.5	1.5	1.5
Samangan	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Baghlan	MM CMD	-	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
Kunduz	MM CMD	-	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
Parwan	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Kabul	MM CMD	-	1.3	2.0	2.7	3.7	4.8	5.3	5.8	6.4	6.5	6.7
Total	**MM CMD**	**-**	**2.3**	**3.4**	**4.5**	**5.7**	**6.9**	**7.5**	**8.2**	**8.9**	**9.1**	**9.3**

.

Annex 12: Total Volumes Case 3

Concept	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Balk (Mazar-e-Sharif)												
Ind.&Com.	MM CFD	-	3.63	5.59	7.64	9.78	12.01	14.34	16.78	19.32	19.79	20.27
Residential	MM CFD	-	0.01	0.01	0.01	0.02	0.03	0.03	0.05	0.06	0.08	0.11
CNG	MM CFD	-	0.10	0.21	0.32	0.44	0.56	0.69	0.83	0.97	1.11	1.27
Fertilizer Plant	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Power Gen.	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Total	MM CFD	-	3.74	5.81	7.97	10.24	12.60	15.07	17.66	20.35	20.99	21.65
Jawzjan (Sheberghan)												
Ind.&Com.	MM CFD	-	0.79	1.21	1.65	2.10	2.57	3.05	3.56	4.08	4.16	4.24
Residential	MM CFD	-	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03
CNG	MM CFD	-	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.05	0.06	0.07
Fertilizer Plant	MM CFD	-	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51
Power Gen.	MM CFD	-	42.14	63.21	84.27	105.34	126.41	126.41	126.41	126.41	126.41	126.41
Total	MM CFD	-	49.46	70.95	92.46	113.99	135.54	136.03	136.55	137.08	137.17	137.27
Samangan												
Ind.&Com.	MM CFD	-	0.20	0.30	0.39	0.49	0.59	0.69	0.79	0.89	0.89	0.89
Residential	MM CFD	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CNG	MM CFD	-	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Fertilizer Plant	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Power Gen.	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Total	MM CFD	-	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	0.90	0.90
Baghlan												
Ind.&Com.	MM CFD	-	1.05	1.62	2.20	2.80	3.42	4.06	4.73	5.42	5.52	5.63
Residential	MM CFD	-	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04
CNG	MM CFD	-	0.02	0.04	0.07	0.09	0.12	0.14	0.17	0.20	0.22	0.25
Fertilizer Plant	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Power Gen.	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Total	MM CFD	-	1.09	1.67	2.28	2.90	3.55	4.23	4.92	5.65	5.78	5.93
Kunduz												
Ind.&Com.	MM CFD	-	1.39	2.13	2.90	3.71	4.56	5.43	6.35	7.30	7.47	7.64
Residential	MM CFD	-	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.04	0.05	0.06
CNG	MM CFD	-	0.03	0.06	0.10	0.13	0.17	0.21	0.25	0.29	0.34	0.38
Fertilizer Plant	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Power Gen.	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Total	MM CFD	-	1.43	2.20	3.02	3.86	4.75	5.67	6.63	7.63	7.85	8.08
Parwan												
Ind.&Com.	MM CFD	-	0.39	0.59	0.79	0.99	1.19	1.38	1.58	1.78	1.78	1.78
Residential	MM CFD	-	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CNG	MM CFD	-	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03
Fertilizer Plant	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Power Gen.	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Total	MM CFD	-	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	1.81	1.81
Kabul												
Ind.&Com.	MM CFD	-	23.83	36.91	50.77	65.43	80.94	97.34	114.65	132.93	137.08	141.35
Residential	MM CFD	-	0.02	0.03	0.05	0.07	0.12	0.20	0.33	0.54	0.88	1.44
CNG	MM CFD	-	0.70	1.45	2.23	3.07	3.95	4.89	5.87	6.92	8.02	9.18
Fertilizer Plant	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Power Gen.	MM CFD	-	-	-	-	-	-	-	-	-	-	-
Total	MM CFD	-	24.54	38.38	53.05	68.58	85.02	102.42	120.85	140.38	145.97	151.97
Total MM CFD												
Ind.&Com.	MM CFD	-	31.28	48.34	66.33	85.30	105.27	126.31	148.44	171.72	176.69	181.80
Residential	MM CFD	-	0.06	0.08	0.10	0.14	0.21	0.30	0.45	0.69	1.07	1.68
CNG	MM CFD	-	0.87	1.78	2.75	3.77	4.85	5.99	7.19	8.46	9.79	11.19
Fertilizer Plant	MM CFD	-	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51	6.51
Power Gen.	MM CFD	-	42.14	63.21	84.27	105.34	126.41	126.41	126.41	126.41	126.41	126.41
Total	**MM CFD**	**-**	**80.9**	**119.9**	**160.0**	**201.1**	**243.3**	**265.5**	**289.0**	**313.8**	**320.5**	**327.6**
Total MM CMD												
Ind.&Com.	MM CMD	-	0.88	1.37	1.88	2.41	2.98	3.57	4.20	4.85	4.99	5.14
Residential	MM CMD	-	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.05
CNG	MM CMD	-	0.02	0.05	0.08	0.11	0.14	0.17	0.20	0.24	0.28	0.32
Fertilizer Plant	MM CMD	-	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Power Gen.	MM CMD	-	1.19	1.79	2.38	2.98	3.57	3.57	3.57	3.57	3.57	3.57
Total	**MM CMD**	**-**	**2.3**	**3.4**	**4.5**	**5.7**	**6.9**	**7.5**	**8.2**	**8.9**	**9.1**	**9.3**
Cumulative	**BCM**	**-**	**0.8**	**2.1**	**3.7**	**5.8**	**8.3**	**11.0**	**14.0**	**17.3**	**20.6**	**24.0**

Volumes per Province

Province	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Balk (Mazar-e-Sharif)	MM CFD	-	3.7	5.8	8.0	10.2	12.6	15.1	17.7	20.4	21.0	21.6
Jawzjan (Sheberghan)	MM CFD	-	49.5	71.0	92.5	114.0	135.5	136.0	136.5	137.1	137.2	137.3
Samangan	MM CFD	-	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.9	0.9
Baghlan	MM CFD	-	1.1	1.7	2.3	2.9	3.6	4.2	4.9	5.6	5.8	5.9
Kunduz	MM CFD	-	1.4	2.2	3.0	3.9	4.7	5.7	6.6	7.6	7.9	8.1
Parwan	MM CFD	-	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	1.8	1.8
Kabul	MM CFD	-	24.5	38.4	53.0	68.6	85.0	102.4	120.9	140.4	146.0	152.0
Total	**MM CFD**	**-**	**80.9**	**119.9**	**160.0**	**201.1**	**243.3**	**265.5**	**289.0**	**313.8**	**320.5**	**327.6**
Balk (Mazar-e-Sharif)	MM CMD	-	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.6	0.6	0.6
Jawzjan (Sheberghan)	MM CMD	-	1.4	2.0	2.6	3.2	3.8	3.8	3.9	3.9	3.9	3.9
Samangan	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Baghlan	MM CMD	-	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
Kunduz	MM CMD	-	0.0	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
Parwan	MM CMD	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
Kabul	MM CMD	-	0.7	1.1	1.5	1.9	2.4	2.9	3.4	4.0	4.1	4.3
Total	**MM CMD**	**-**	**2.3**	**3.4**	**4.5**	**5.7**	**6.9**	**7.5**	**8.2**	**8.9**	**9.1**	**9.3**