MINING INFRASTRUCTURE INVESTMENT SUPPORT PROJECT

TERMS OF REFERENCE FOR THE DEVELOPMENT OF A FEASIBILITY STUDY ON COAL-TO-SYNTHETIC NATURAL GAS (Coal to SNG) PLANT

Project Ref. No: WB/MOF/MINIS/CS/QCBS/1.1.8 (c)/2015

Date: 9th April 2015
ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME</td>
<td>Ministry of Energy</td>
</tr>
<tr>
<td>STC</td>
<td>Science and Technology Committee</td>
</tr>
<tr>
<td>MEGD</td>
<td>Ministry of Environment and Green development</td>
</tr>
<tr>
<td>ESIA</td>
<td>Environmental and Social Impact Assessment</td>
</tr>
<tr>
<td>UN</td>
<td>United Nations</td>
</tr>
<tr>
<td>FS</td>
<td>Feasibility Study</td>
</tr>
<tr>
<td>CEG</td>
<td>Central Energy Grid</td>
</tr>
<tr>
<td>PIU</td>
<td>Project Implementing Unit</td>
</tr>
<tr>
<td>MINIS</td>
<td>Mining Infrastructure Investment Support Project</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>TPP</td>
<td>Thermoelectric Power Plant</td>
</tr>
</tbody>
</table>
A. Table of Contents

A. GENERAL INFORMATION ................................................................. 5

1. Introduction .................................................................................... 5
  1.1. Preface ...................................................................................... 5
  1.2. The Government Policy of Mongolia ........................................... 5
  1.3. Project Concept .......................................................................... 7
  1.4. Preliminary Research .................................................................. 7
  1.5. Coal mines considered with the scope of the project .................. 8
  1.6. Legal environment and policy analysis ........................................ 8

2. Terms for the Development of the Feasibility Study ......................... 10
  2.1. Requirements for the Feasibility Study ....................................... 10
  2.2. Objectives of research stages .................................................... 10

B. RESEARCH TASKS ........................................................................ 12

3. Preliminary Feasibility Study .......................................................... 12
  3.1. Research on Technological Selection ........................................... 12
    3.1.1. Comparative study on coal to SNG technologies .................. 12
    3.1.2. Distribution of coal deposits in Mongolia and the selection of an appropriate deposit 12
    3.1.3. Selection of suitable technology for the selected deposit, and plant capacity .......... 13
    3.1.4. Supply raw materials for production, and Possibilities ............... 13
  3.2. Consumer Market Research ....................................................... 13
    3.2.1. Components and location of SNG consumers ....................... 13
    3.2.2. SNG price and market opportunity ...................................... 13
    3.2.3. Provisional planning for SNG distribution network ............... 13
  3.3. Economic analysis ..................................................................... 14
    3.3.1. Total Project Investment and Cost Estimation ....................... 14
    3.3.2. Operational costs ............................................................... 14
    3.3.3. Main and by-product market and revenues ............................ 14
    3.3.4. Financial and Economic Analysis, and Risk Assessment .......... 14
    3.3.5. Procedure for Project Implementation and Investment Plan for Construction .... 14

4. Feasibility Study’s research ............................................................. 15
  4.1. Cadastral and Geodetic Survey of Project Site ............................. 15
  4.2. Raw material deposits, characteristics and supply information ....... 15
  4.3. Plant’s process equipment and technical specification .................. 15
  4.4. Main and ancillary facilities, infrastructure, road and water supply ... 16
  4.5. Construction plan and supply of construction materials ............... 16
  4.6. Human Resource Administration and Management ..................... 16
  4.7. Occupational Safety and Health ............................................... 16
  4.8. Socio-economic Analysis of the Project ...................................... 17
  4.9. Environmental Impact Assessment and Management of Greenhouse Gases .... 17

C. REQUIREMENTS FOR CONSULTING............................................. 19
5. **Outcome** .................................................................................................................................................. 19

5.1. **Documents** ......................................................................................................................................... 19

5.1.1. Preliminary Research Report .............................................................................................................. 19

5.1.2. Feasibility Study Report ....................................................................................................................... 19

5.2. **Conditions for Project Implementation** ............................................................................................ 20

5.2.1. Obligations and Responsibilities ........................................................................................................ 20

5.2.2. Consulting Work Schedule ................................................................................................................. 21

5.2.3. Ownership of Information and Documents ......................................................................................... 21

5.2.4. Performance Schedule ....................................................................................................................... 21

5.3. **Requirements for professional competency of consulting team** ..................................................... 22

5.4. **Payment Schedule** .............................................................................................................................. 25
A. GENERAL INFORMATION

1. Introduction

1.1. Preface

The Mining Infrastructure Investment Support Project (MINIS), which is financed by the World Bank aims to encourage investment in infrastructure by scaling up investment in infrastructure to support value-added operations in fuel, energy and mining sectors irrespective of their investment sources, and to strengthen domestic capacity for preparation and implementation of infrastructure projects. In the scope of the project, “Project to Develop Feasibility Study on Coal to SNG Plant and to Conduct General Environmental Impact Assessment” is included into the scope of this project, and the implementation of the project is a critical issue of resolving environmental problems surrounding fuel and energy supply for urban and domestic settlements.

Capital Ulaanbaatar with a population of over 1.3 million and consumers in other economic centers in the central region of the country account for 95 percent of net energy consumption in Mongolia. The central heating system of Ulaanbaatar reaches residents only in downtown area, whereas residents of uptown areas and such public service establishments as schools, kindergartens and hospitals operating in those areas obtain their heating supplies from 170 low-performance boilers that run on raw coal and common furnaces in over 140 thousand households. The average coefficient of efficiency in these furnaces being around 50-60% means that these furnaces do not fully satisfy the demands of their consumers and become one of the major sources of air and soil pollution and thus have adverse effects on the health of the residents. Studies have shown that there were 951 busses in 2013, of which 20% had served more than 12 years.

It says in Mongolian National Standard MNS 5012-2008 that “Operation of busses that have served in public transportation more than 12 years is prohibited”. Coal-to-SNG plant has great importance of increasing the price of raw lignite, strengthening Mongolian economic capacity, resolving the issue of air pollution that is severely affecting the health of residents of Ulaanbaatar, and establishing domestic gas fuel resources to reduce fuel imports. The Feasibility study and general environmental assessment are required to contain vital information and economic assessment for making a decision on project investment.

1.2. The Government Policy of Mongolia

The State IlkhKhural and the Government of Mongolia has adopted the following policy on fuel, energy supply and environmental issues of urban settlements.

1. It is stated in the Strategic Objective 1 of Phase one (2007-2015) of Section 5.2.1.1. Development policy for geology, mining and minerals, and heavy industries of Comprehensive National Development Strategy of Mongolia that “to start the exploration of strategic coal deposit of Choir-Nyalga coal-bearing basin; to develop coal processing technologies to produce fuel from coal; to increase the production of value-added products by improving the level of raw mineral processing”; in the Strategic Objective 2 of phase two (2016-2021) of Section 5.2.1.2. Policy of Processing Industry that “to develop chemical industries and introduce complete coal processing technologies to produce various types of end products and export them”; in the Strategic Objective 1 of Phase one (2007-2015) of Section 5.3.3. Fuel Sector Development Policy that “to supply small-scale power plants with fuel gas from coal
gasification; and to establish small-scale plants to produce smokeless fuel from coal”; in the Strategic Objective 1 of both phases (2007-2012) within the framework development priority No.5 of Mongolia that “to limit and halt environmental pollution and degradation; to implement a set of legal, economic, management and organizational measures to reduce air pollution of capital Ulaanbaatar and other major cities; to implement a joint project to reduce emission of greenhouse gases and sell the greenhouse gases at market prices within the scope of Clean Development Mechanism (CDM) of the Kyoto Protocol”.

2. In “Measure to Reduce Air Pollution” section of mid-term program of the “New Development”, approved by the State IkhKhural, it is that by 2016, fuel gas will have been introduced into application and the use of clean coal and new energy sources for heating boilers will have been implemented.

3. It is stated in the Section 4 – Competitive Factors of Industrial Sectors, National Industrialization Plan, that relying upon domestic raw materials is an important factor of industrialization plan. Domestic processing of mineral raw materials will provide conditions for the development of industries, scaling up exports, increasing the variety of exports, creating new jobs, increasing the yield, increasing national profit by producing value-added products, raising the number of tax payers and reducing the level of poverty. In section 8.3, it is stated that variety and production of value-added exports will be increased by increasing raw material processing. Section 9.5 state the objective to develop comprehensive and regulated industrialization through raw material processing and the production of end products. In section 14.1, it is stated that reconstruction and extension of infrastructure for industrial facilities will be carried out with investment from a partnership between state and private entities in accordance with industrialization plan and regional development requirements.

4. In “Mongolian citizen in Safe Environment” chapter of Mongolian Government Action Plant for 2012-2016, it is stated that “Comprehensive reform policy to fight smog and air pollution of capital Ulaanbaatar shall be implement”.

5. In “Export support policy to replace import” chapter of Mongolian Government Action Plant for 2012-2016, it is stated that “actions to produce fuel gas and liquid from coal shall be intensified and research on the development of oil shale and coal chemical industries shall be conducted”.

6. EQUITABLE AND SUSTAINABLE GROWTH- In the section 2.21 of Collaborative Action Plan between Government of Mongolia and UNDP, it emphasized the need for implementing those mid-term action plans by encouraging energy efficient technologies along with long-term actions to reduce air pollution and the emission of greenhouse gases.

7. From 1998 through 2002, Government supported coal mines in scaling up their capacity of coal exploration by investing over 80 million tugrik’s in two state-owned coal mines, namely Baganuur and Shivee-Ovoo, to renovate their equipment and facilities.

8. “Coal Mongolia” forum is organized in capital Ulaanbaatar, with some 1000 domestic and international representatives participating each year. Over the last few years, the forum has attracted much foreign investment in coal sector of Mongolia to make the coal sector one of the country’s economic mainstays. According to international experts, Mongolia has at least 100 billion tons of coal reserves, and it is estimated
that the coal exploration will continue to rise to reach an annual exploration of 40-60 million tons, and it will be possible to explore 100 million tons of coal per annum.

1.3. Project Concept

Terms of reference for the “Development of Feasibility Study on Coal-to-SNG Plant Project” were prepared based on preliminary studies on the environment, socio-economic and financial viabilities. The research report was prepared in compliance with guidelines provided by the World Bank, and was approved during the meeting of PIU of Mongolian Ministry of Energy after taking relevant comments and suggestion into consideration for the report.

It is required that economically profitable lignite deposit with less environmental impact be selected among lignite deposits in lignite coal-bearing basins of Mongolian central region, and process technology which is suitable for the selected coal quality be chosen, and plant’s construction site be selected in relation to location of its raw material and water sources. The implementation of the project has great advantages of improving Mongolian economic capacity, providing reliable supplies of clean fuel gas and electricity to residents of capital Ulaanbaatar, and reducing air and soil pollution in the city and providing safe and comfortable living environment for the residents.

1.4. Preliminary Research

Preliminary research was conducted during the preparation of terms and references for the development of proposed feasibility study. Comparison of coal deposits based on their coal reserves, technical viability, economic and financial feasibility, and socio-environmental impacts indicates that coal deposits in the Central region, namely, Baganuur, Shivee-Ovoo and Tevshiin Gobi, are most feasible coal deposits for the project. Although it is required that coal deposit to be explored within the scope of the project be selected during the development stage of the feasibility study, the preliminary research shows that project site will be located in the central region.

It may be economically profitable to construct the coal-to-SNG plant nearby capital Ulaanbaatar. However, the exact location and process technology of the plant will be precisely defined after considering plant’s economic and technical factors during the development stage of the feasibility study.

Although the project will be profitable in terms of economic and technical indicators, it is not feasible to implement the project without evaluating its social-economic impacts. Therefore, results of environmental impact assessment and social-economic analysis should be sufficiently satisfactory to obtain foreign investment. Procedures and detailed requirements provided in this guideline are set in compliance with guidelines of the World Bank and Laws and Regulations of Mongolia.

Research and evaluation to be conducted during the preparation of the feasibility study on coal-to-SNG plant should faithfully estimate the project profit and contain sufficient information to facilitate making a decision on project investment, and the research will provide basis for developing work plan.
1.5. **Coal mines considered with the scope of the project**

Fossilized fuel, particularly coal, is major component in energy resources of Mongolia. 71, 5% of the country’s total coal reserves are located in central region, 23, 6% in eastern region, 2, 9% in western region and 2% in Khangai region.

84% of total coal explored per annum is used in thermoelectric power plants and heating boilers, 6% is used in household furnaces, 9% is used for industrial purpose and the remaining percentage is used by other consumers. Although this supply of domestic coal to satisfy the energy demands of rural areas has the advantage of being cheap, it has a great disadvantage of polluting the environment with its combustion products, namely ash and smog.

Coal demands of thermoelectric power plants in capital Ulaanbaatar are met by lignite supply from Baganuur and Shivee-Ovoo mines. Coal characteristics and reserves of these mines have been thoroughly studied, and the mines have advantage of transporting their coal to consumers in urban area by railway. Therefore, it is socio-economically advantageous to build the coal-to-SNG plant based on Shivee-Ovoo, Baganuur, Tevshiin Gobi and TugrugNuur coal deposits in Choir-Nyalga coal-bearing basin. The production of SNG from coal provides comprehensible approach towards meeting energy demands of urban areas and resolving environmental issues. The Figure No.1 illustrates locations of coal mines considered within the scope of the project.

1.6. **Legal environment and policy analysis**

Since the successful implementation of any project depends largely on its compliance with relevant International and regional documents, laws and agreements, it is necessary to review legal environment and relevant legal documents surrounding the project.

Relevant effective international conventions and bilateral agreements in which Mongolia is a party and relevant Mongolian laws, policy documents and other legal documents will be reviewed within the scope of this project. If it is required, relevant legal documents will be used in the preparation of the feasibility study.

Study on legal environment surrounding the implementation of the project makes it possible to identify any international and regional legal factor and validity, and to give answers, on legal background, to public misunderstanding and irrelevant information concerning the implementation of the project, and to accurately evaluate, address and be ready for any external and internal risk involved in the implementation of the project, and lays the legal foundation for the successful implementation of the project.

The Consultant shall work to comply with relevant Mongolian laws and regulations, and policies of the World Bank within the framework of above requirements.
Figure 1. Locations of coal mines considered within the scope of the project. - **7. Choir-Nyalga**
2 Terms for the Development of the Feasibility Study

2.1. Requirements for the Feasibility Study

The purpose of this feasibility study is to carry out analysis on the feasibility of “Coal-to-SNG plant project” in terms of engineering, financial and economic criteria. The feasibility study should meet the following requirements:

- To perform thorough analysis on technology, financial and economic factors with high degree of professional execution;
- To develop a plan for the preparation of the feasibility study;
- To estimate required budget amount, and to define the validity of implementing project after compiling evaluations of technical and economic assessment, investment, social and environmental impacts;
- To find solutions to the trend of SNG use and consumption yield;
- To develop schedule for supplying the plant with water;
- To study selection of technology for the module plant

The feasibility study should be prepared in compliance with relevant effective laws and regulation of Mongolia, and Construction Norms and Regulations, and be prepared with satisfactory degree of performance that meets international requirements. The results of the feasibility study will depend on environmental impact assessment that complies with policies of the World Bank. The feasibility study should be prepared with a degree of performance that is satisfactory to make a decision on investment in terms of precision and quality.

The Consultant may be domestic or foreign company that has relevant experiences on similar projects and has a legal permission to develop engineering drawing and conduct feasibility study research in Mongolia, and may be a partnership of companies that satisfy these criteria. Inclusion, by the participant parties, of opinions and comments of civil societies and non-government organizations in the proposed project shall suffice to provide the proof of validity.

2.2. Objectives of research stages

The development of feasibility study on a coal-to-SNG plant will be carried out in accordance with Mongolian and International rules, requirements and standards and those of the World Bank, and each stage mentioned below will be thoroughly completed.

1. The First Stage - Preliminary Study. In the first stage of the development of the Feasibility Study, feasible alternatives for the construction of the coal-to-SNG plant will identified, and these include:

- To select a coal deposit and decide on project site based on the evaluation of process technology, raw material, source of water and SNG market;
- To estimate plant’s capacity based on Scenario 1: capacity of household furnaces and heating boilers of organizations inger districts of capital Ulaanbaatar and Scenario 2: accommodate for SNG supply to heat and power generation plants;
- To conduct comparative study on yield efficiencies and carbon balance of various coal gasification technologies, and to select certified, most effective (taking into consideration efficiency and low carbon footprint) technology that produces best quality SNG;

- To conduct comparative study on the carbon footprint for of the various coal gasification technologies compared to the direct use of coal for heating and power generation end use. This would be carried with and without carbon capture and storage CCS technologies.

- To perform thorough economic and financial analysis on investment, equipment, process technology and consumer market, and make a proposal and draw a conclusion;

- To gather technical, financial and investment data and documents that are necessary for the next stage of the project;

- To make a plan for project implementation, and to set a financing schedule

2. **The Second Stage - Feasibility Study’s research:** In this stage, detailed study will be conducted on an alternative which was deemed to be best in the first stage of the preliminary research. Objectives include:
   a. To set comprehensive technical requirements;
   b. To finalize locations of facilities and requirements for land utilization;
   c. To carry out estimation of raw material supply, infrastructure and supply of construction materials;
   d. To make engineering and infrastructure models to meet the demand of SNG market;
   e. To complete and sum up technical specifications and numerical data;
   f. To prepare construction drawing of facilities and to determine requirements for the project;
   g. To plan plant’s administration, management and the conditions of occupational safety;
   h. To conduct General Environmental Impact Assessment;
   i. To conduct project’s social-economic impact and risk assessment;
   j. To evaluate legal environment and policy issues surrounding the implementation of the project.

In the development of the feasibility study, previous research materials and recent research data may be used; however, new research should be conducted. The consulting service will be finished upon submission of the feasibility study to the Client after its review and approval in accordance with rules and regulations of the World Bank and Government of Mongolia.
B. RESEARCH TASKS

3. Preliminary Feasibility Study

3.1. Research on Technological Selection

Preliminary feasibility study covers the following:

- Research on technological selection
- Consumer market research
- Economic analysis

The best alternative will be selected on the basis of comparing technologies selected in the preliminary study. Raw material deposits, sources of water, target consumer markets and appropriate project site will be identified and included in financial analysis and the estimation of investment and operational costs.

At least three sites for the project location will be comparatively studied in this phase. The selection of gas transport pipelines and substations will be made upon comparison of no less than two alternatives.

Research basis for the Feasibility study will be established in preliminary research stage.

Reports and results will be completed and submitted in accordance with the requirements set in Section 5.

3.1.1. Comparative study on coal to SNG technologies

By conducting comparative studies on international coal gasification and methanation technologies, advanced and environmentally friendly technology, of which process technology has been certified and is being practiced in current global coal chemistry sector and is most efficient and suitable for domestic coal reserves of Mongolia will be introduced.

3.1.2. Comparative study on carbon cycle

Comparative study should be conducted by each of following alternatives:

- Producing heat by burning raw coal, and/or converting coal to Syntethic Natural Gas
- Producing steam for steam turbine by burning coal, and/or converting coal to SNG for integrated gasification combined cycle
- Converting diesel fuel to energy (for public transportation), and/or converting coal to SNG for energy and
- With or without Carbon capture and storage.

3.1.3. Distribution of coal deposits in Mongolia and the selection of an appropriate deposit

To implement project to produce and provide, over 50 years, stable and reliable supply of SNG from lignite reserves of Choir-Nyalgacoal-bearing basin located in central region of Mongolia, and to select suitable coal deposit location and to study its industrial reserves and operational possibilities.
3.1.4. Selection of suitable technology for the selected deposit, and plant capacity

To propose based on information of coal deposits in Mongolia, alternatives of coal gasification and methanation technology and equipment that are most suitable for coal quality of a selected coal deposit, and estimation of coal-to-SNG plant’s capacity.

3.1.5. Supply raw materials for production, and Possibilities

Other than the main raw material, the consumption of water, energy, material and chemicals which are essential for the process technology will be estimated for the normal operation of the coal-to-SNG plant, and alternatives of the supply of materials from domestic and international sources will be chosen.

3.1.5 General Planning for Plant’s Infrastructure, and main and ancillary facilities

For the general planning of plant’s infrastructure, and main and ancillary facilities, following drawing will be included:

- Schema of plant’s main facility,
- Plan drawing of plant’s construction field,
- Schematic drawing of connection of plant’s main pieces of equipment,
- Process flow for plant’s ancillary facilities and by-products

3.2. Consumer Market Research

This study focuses on replacing the consumption of raw coal by residents of capital Ulaanbaatar with synthetic natural gas, and the possibility of meeting increasing energy demands with SNG.

3.2.1. Components and location of SNG consumers

To determine potential SNG consumer market’s components /segments/ for capital Ulaanbaatar and rural settlements, and to estimate consumption level and capacity for replacing, the use of low-performance boilers and furnaces, household heating system and hot water supply with 100 per cent natural gas, and to study possibilities of introducing natural fuel gas for public transportation and power generation and to identify the distribution and location of SNG consumers.

3.2.2. SNG price and market opportunity

Different tariffs on SNG will be estimated in different consumer categories in view of unit cost of SNG transportation, consumer capability and social features, and evaluation of service costs of SNG supply

3.2.3. Provisional planning for SNG distribution network

To develop an engineering solution to the distribution of SNG to consumers and to develop a provisional plan drawing for the infrastructure construction and to distribute and store SNG supplies via most appropriate means with maximum possible efficiency and to select the most suitable itineraries for main and ancillary pipelines based on technical and economic comparison of no less than two alternative itineraries.
3.3. Economic analysis

Economic and financial analysis will be carried out based on results of preliminary research on equipment, process technology and consumption, and the results will be reported in numerical values.

3.3.1. Total Project Investment and Cost Estimation

To evaluate project investment in categories of plant’s main and ancillary facilities, infrastructure, mining investment and construction, and to estimate the Total Project Investment in terms U.S. dollar as it is the international standard. This will cover the two scenarios of the end use. Namely, with and without provisions to meet the supply for power generation purposes:

3.3.2. Operational costs

For a chosen project alternative, operational cost including, but not limited to, following will be estimated for the economic and financial analysis:

- Plant’s operational costs
- Raw material costs
- Workforce and management costs
- Depreciation costs
- Investment loan interest
- Taxes and levies
- Costs related to the Environmental and social purposes
- Other costs

Variable costs will be estimated for each component and included in the analysis.

3.3.3. Main and by-product market and revenues

The dependence of plant’s profitable operation on SNG price and the plant’s operational costs will be analyzed. The total revenue will consist of revenues from the sale of SNG and its by-product, and prevailing global market price for SNG will be taken into consideration.

Also, costs, prices and the use of process by-products will be studied, and the competitiveness of the product will be evaluated by estimating the plants operational accosts and unit price of the product.

3.3.4. Financial and Economic Analysis, and Risk Assessment

Economic benefits will be evaluated by comparing plant’s operational costs and revenues, and the break-even for project investment will be defined.

Exchange rate fluctuation and product’s price trend will be taken into account in economic analysis.

3.3.5. Procedure for Project Implementation and Investment Plan for Construction

To develop construction plan for plant’s facilities, infrastructure and the mine according to set schedule, and to make annual estimations of necessary investments for each scheduled work, and to propose financing methods for each annual investment, and to make a loan payment plan if the investment is to be financed by a loan.
4. Feasibility Study’s research

Following tasks will be accomplished to complete the feasibility study based on the results of the preliminary research:

- To conduct cadastral and geodetic survey of the project site
- To merge information on raw material deposits and characteristics and supply
- To provide information on plant’s process equipment and technical specifications
- To develop planning of plant’s main and ancillary facilities, infrastructure, road and water supply
- To make conclusion of plant’s construction plan and supply of construction material
- To plan human resource administration and management
- To make suggestion about occupational safety and health
- To conduct socio-economic analysis of the project
- To conduct environmental assessment and management of greenhouse gases, etc.,

Feasibility studies research will be carried out for a project site which has been selected in preliminary research.

4.1. Cadastral and Geodetic Survey of Project Site

Location drawing of the plant will be made by considering selected site’s formation, geological and hydro geological conditions, and the climate, and necessary information about plant’s location, field elevation, potential limitations on entire project field and research materials from previous geodetic surveys which have been conducted within the scope of the project will be collected and used in drawing.

National coordinate system of Mongolia will be used in the coordinate. Satellite and aerial survey data may be used in the drawing. Locations of road, human settlements, cultural heritage, transmission lines and other important sites must be marked on the drawing.

4.2. Raw material deposits, characteristics and supply information

The following items will be researched thoroughly in studying coal deposits and coal characteristics and selecting a suitable process technology and pieces of equipment in order to provide normal, reliable and economically profitable operation of the plant:

- Industrial reserves and operational system of a coal mine,
- Results of analysis of coal characteristics verifying the fitness of the selected process technology,
- Transportation proposal to supply the plant with coal
- Estimation of production balance

4.3. Plant’s process equipment and technical specification

The selection of plant’s process equipment and process flow schema will include the following:

- General drawing of the Plant
• Technical specifications, working principle and schema of each process equipment
• List of equipment
• Simplified flow diagram of the process technology and net material balance of a selected equipment
• Energy balance of the process technology
• Water balance of the process technology
• Requirements of catalysts and chemicals
• Process flow diagram for gases and liquids
• Drawing indicating the placement of process equipment
• Connection schemas
• Carbon capturing and storage

4.4. **Main and ancillary facilities, infrastructure, road and water supply**

Planning of infrastructure and pipelines that are necessary for the operation of the plant will be included in construction planning, and these include the following:

• Construction drawing of plant's main facilities, and a list of requirements and standards for engineering drawing;
• General plan drawing of road and construction field;
• Supply of steam, water, gases and oxygen that are necessary for the process technology, and supply of equipment and chemical additives, and engineering plan drawing for supply of electricity, heat and water, and a sewerage system.

Technical proposal of communication network and automation may be included in infrastructure facilities.

4.5. **Construction plan and supply of construction materials**

Transport mode and transport route of construction materials to the construction field, and ecological requirements, and the evacuation of people etc., will be considered in making the construction schema.

• Work plan for project stages;
• Work plan for reaching the full capacity of the plant;
• Probable delay in the course of construction work, and measures to eliminate the delay.

A report of construction materials required for the construction work will be prepared, and domestic and foreign sources will be identified.

4.6. **Human Resource Administration and Management**

The number of transient and permanent employees for plant’s construction, operation, and maintenance will be estimated, and plant’s organizational structure and general plan for preparing technical and specialized professional staff will be prepared.

The percentage of foreign employees may be included.

4.7. **Occupational Safety and Health**

The main objective of this study is to protect the safety and health of transient and permanent employees for construction and operation of the plant facilities, and measures to
be taken to prevent potential risks will be defined, and a plan for providing safety and health of the employees will be developed, and risk management and risk assessment strategies will be prepared.

Also, safety monitoring and evaluation strategy will be prepared, and these include the following:

- Accident and fire prevention system for the implementation of the project;
- Occupational safety and health management system;
- Documents and guidelines for safe operation;
- Extremely dangerous operations

### 4.8. Socio-economic Analysis of the Project

Economic comparison will be carried out before and after the implementation of the project, and economic and financial analysis for the project revenue will be conducted.

- Estimation of input and out of production
- Analysis of product price, base price, market and risks
- Analysis of investment, funding and financial risks

The validity of economic benefits of the project should be evaluated based not only on economic profits, but also social and environmental benefits. Project’s feasibility, outcome and possibility of imposing adverse effects on the economy of Mongolia and feasibility should be evaluated. Conditions for maintaining ecological balance should be taken into consideration for the use of water in coal-to-SNG process technology. Social benefits of the project will be expressed in economic analysis, and it is determined by direct and indirect means, and expressed by the following:

- Increase in the amount of clean fuel supply to satisfy demands of domestic applications and generation of thermoelectric energy
- Improve of air quality in urban settlements
- Changes in Electricity and Heating Tariff
- Reduction in unproductive social expenses
- Increase in the number of available jobs
- Increase in household income

GDP growth forecast and tax influence analysis should be carried out on the following by direct and indirect measurements:

- State Budget;
- Provincial Budget;
- Profits to local administration;
- Regional household income

### 4.9. Environmental Impact Assessment and Management of Greenhouse Gases

A full Environmental and Social Impact Assessment will be carried out in parallel by a different consultant and the two studies need to overlap. Environmental impact assessment will be conducted in relation to the following:
The use of equipment and technology to keep levels of exhaust gases, dusts, particulate matter and the emission of solid, liquid and gaseous waste from the plant at levels that are permissible in accordance with international standards;
To reduce the emission of waste, and to control dust, and treat waste water;
To establish conditions for maximizing the use of recycled water;
To eliminate potential emission of toxic and dangerous volatile matter, chemicals, water steam and pollutants to the environment;
To implement solutions to recycle greenhouse gases emitted from the plant or to prevent from being released into the atmosphere.

Evaluation of necessary legal regulations on implementing the project, especially project’s compliance with relevant international standards and requirements to protect the environment, will be performed, and research and suggestions on implementing the policies of the World Bank and Mongolian government will be made.
C. REQUIREMENTS OF THE CONSULTANT

5. Outcome

A Feasibility study is a research to develop engineering and technical solution in view of financial, economic, social and environmental factors. The results of the research provide basis for making a decision about feasibility of a project.

5.1. Documents

Within the scope of the project, inception report, progress reports and final report should be prepared in both English and Mongolian for each step of the project. Unless stated otherwise in the agreement, reports shall be submitted to the World Bank as specified in the following schedule through Project implementation unit of the “Mining Infrastructure Investment Support Project”.

Inception Report (Action plan and work schedule): Action plan and work schedule within the scope of the contract will be included in this report, and it should be submitted to the Project Implementation Unit within 30 days after receiving the official letter awarding the contract.

Progress Reports: Progress reports shall be submitted to the Project Implementation Unit in every 2 months after signing the contract. The progress reports should be concise and no more than 1-3 pages long and should refer to any problem to accomplishing the objectives of the project, proposed alternative, budget, and performance of scheduled works.

Final report: The first draft of final project report may be prepared in either Mongolian or English, and be submitted to the Project implementation unit for review. After taking comments and suggestions from Mongolian Ministry of Energy and other government and public bodies, final report should be prepared in both English and Mongolia.

5.1.1. Preliminary Research Report

Inception report (action plan and work schedule) on preliminary research findings and results of recent research and activities covered in the preliminary Research phase shall be prepared and submitted to the Project Implementation Unit.

Draft final report on operations which were conducted within the scope of preliminary research, information, summary, and comments shall be presented as an interim report to the Project Implementation Unit for review on month prior to the discussion of the final report.

The final report on preliminary research shall be prepared according requirements set by the World Bank and Government of Mongolia for its contents and format, and it shall include reflect opinions of public organizations.

5.1.2. Feasibility Study Report

Action plan and program based on preliminary study and final stage information of FS should be submitted to PIU within a month upon summary of Science and Technical Steering Committee.
Interim report (draft final report), which included actions in the frame of action plan, should be submitted to PIU for its review a month before to discuss final report at the Science and Technical Steering Committee.

A clear presentation concerning the scope and objectives of the proposed Project should be done with assessment of its technical, environmental and social-economic feasibility under current conditions, and integration of government and public comments. Community comments through consultations should be undertaken. Discussed issues should be received written form and will be considered for final report.

Final report will be prepared within 8 months after Science and Technical Steering Committee’s summary, in form of World Bank and Government of Mongolia standards and written form of tables, figures and/or maps as needed.

Draft final report should be reviewed by the expertise who reviewed preliminary study.

The Final Study should provide complete details of all work performed, analyses made, and justification of selected options, proposed design and scheme filed according to TOR, and should be submitted for discussion and approval of the Science and Technical Steering Committee of Ministry of Energy.

All reports, research, analysis, grounds for options, drawings and schemes will be combined for approval for the Science and Technology Council of the Ministry of Energy and delivered electronically in Adobe PDF and Word DOCX format for both Mongolian and English Versions, with CD and hard 3 copies of Approved Final Report to both PIU and MOE.

5.2. Conditions for Project Implementation

5.2.1. Obligations and Responsibilities

Roles and Responsibilities of Project Implementing Unit: Project Implementation Unit for the “Mining Infrastructure Investment Support Project” of the World Bank shall monitor the performance of the Consultant in compliance with terms of references for the project, and shall receive reports of each research phase and organize review and discussion of the reports by relevant competent organizations. The project implementation unit shall constantly monitor the consulting and report, to the Client, about the performance of the consulting services.

Roles and Responsibilities of the Client: Within the scope of this project, Mongolian Ministry of Energy shall be the Client. During the research, working group under Mongolian Ministry of Energy shall conduct indirect monitoring through the Project Implementing Unit and shall hold discussions on reports of the research phases and shall award required permissions.

Roles and Responsibilities of the Consultant: The Consultant shall organize its operations with transparent and integrated management in order to efficiently prepare the feasibility study on due time. The Consultant shall cooperate with other parties and shall hold meetings with management, chief experts and other experts of the research on regular basis and shall officially exchange documents and information. Also, the Consultant shall present and submit, to the Project Implementation Unit and the Client, reports on its performance as specified in work execution schedule for review and discussion, and shall consider their comments and suggestions for approval.
5.2.2. Consulting Work Schedule

Mongolian Ministry of Energy, otherwise referred to as the Client, shall monitor progress of the Consultant through Project Implementation Unit, and shall organize cooperation with other ministries, government agencies and international organizations. Also, it shall provide assistance in communication with science and research institutes, civil society organizations as well as non-government organizations.

The Consultant shall present performance reports, in written format, in every two months throughout the implementation of the project, and this will assist the Client in deciding whether any activity is within the scope of the project or not. Work plan and performance reports made by the Consultant should be prepared in both Mongolian and English.

Table No. 1 shows definitions and relevant periods of each report. The consulting team shall commence its operation upon signing the agreement with satisfaction.

5.2.3. Ownership of Information and Documents

All information, reports and documents that are provided by the Consultant will be properties of the Consultant. Disclose, by the PUI and Ministry of Energy, of the materials provided by the Consultant without its written concession will be prohibited.

5.2.4. Performance Schedule

“The Development of Feasibility Study on Coal-to-SNG Plant Project” will be completed in 12 months. In Detail, 8 months for the preliminary research and 4 months for the preparation of the feasibility study.

Table No. 1 shows a schedule for project implementation along with submission of reports.
### Table 1. Research schedule for "The Development of Feasibility Study on Coal-to-SNG Plant" project

<table>
<thead>
<tr>
<th>NO.</th>
<th>Work Item</th>
<th>Month1</th>
<th>Month2</th>
<th>Month3</th>
<th>Month4</th>
<th>Month5</th>
<th>Month6</th>
<th>Month7</th>
<th>Month8</th>
<th>Month9</th>
<th>Month10</th>
<th>Month11</th>
<th>Month12</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1st stage. Preliminary Feasibility Study</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.1. Present an inception report that included Work Breakdown Schedule and Action Plans of feasibility study project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.2. Collect research data and conduct research</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.3. Present an interim report of preliminary research to the PIU, organize related discussions and seminars.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>2nd stage. Detailed Feasibility study</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.1. Submit a Work Breakdown Schedule for the development of detailed feasibility study</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.2. Collect all data and conduct research</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.3. Review and Draft an Interim report of Feasibility study.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.4. Present the Interim Report to the PIU and get comments.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.5. Prepare a Final Draft below PIU comments and present to the PIU.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.6. Take comments and suggestions from external experts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.7. Get approval from Science and Technical Commissions of Ministry of Energy and submit final report</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.3. Requirements for professional competency of consulting team

The firm or the leading firm/main consultant in case of associations should have an international or regional similar coal processing and related FS preparation experience for the last 5 years. Consultants may associate with other firms in the form of a joint venture or a sub consultancy to enhance their qualifications.

The consultant will provide details about responsibilities of a work place and names of personnel assigned for the work along with their professional competency and experience. The consultant will also assign project’s chief and executive leaders as well as chief members and personnel to be employed for a short period of time on special professional requirements.

Availability of proposed project team members for duration of the project implementation will be verified.

Table 2: Chief professionals of consulting team for the development of the feasibility study

<table>
<thead>
<tr>
<th>Core Professionals (foreign)</th>
<th>Man-month</th>
<th>Core Professionals (local)</th>
<th>Man-month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Director</td>
<td>12</td>
<td>Project Director</td>
<td>12</td>
</tr>
<tr>
<td>Project Manager</td>
<td>12</td>
<td>Project Manager</td>
<td>12</td>
</tr>
<tr>
<td>Financial and Economic Research Team Leader</td>
<td>12</td>
<td>Financial and Economic Research Team Leader</td>
<td>12</td>
</tr>
<tr>
<td>Technical Research Team Leader</td>
<td>12</td>
<td>Technical Research Team Leader</td>
<td>12</td>
</tr>
<tr>
<td>Chemical Technology Engineer</td>
<td>12</td>
<td>Chemical Technology Engineer</td>
<td>12</td>
</tr>
<tr>
<td>Financial and Economical Specialist</td>
<td>12</td>
<td>Financial and Economical Specialist</td>
<td>12</td>
</tr>
<tr>
<td>Other necessary professionals</td>
<td>Man-month</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planning Specialist</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drawing Engineer</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drawing Operator</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mining Engineer</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Engineer</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction Engineer</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat Engineer</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IT Engineer</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil and Gas Engineer</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geodetic Engineer</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geologist</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Specialist</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>183</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Minimum qualifications of core specialists are presented below:

**Project director is expected to meet following criteria:**
- Should hold a M.BA degree or a professional higher degree (at least Master degree) in his/her field.
- Should have worked in energy and mining sectors for more than 10 years, and should have held management level position for than 5 years, and should have experience in professional project management, leading a project on preparing feasibility studies on construction of coal processing plants, and should have a professional consulting qualification.
- Implement a project in cooperation with the Government or a government-owned organization.
- Should have analytical, problem solving and decision making skills, and should be able to lead a team that is comprised of multinational professionals.

**Project manager is expected meet following criteria:**
- Should hold a M.BA degree or a professional degree (Master’s degree or above) in his/her field.
- Should have worked in energy and mining sectors for more than 10 years, and should have held management level position for than 5 years, and should have experience in project management, leading a project on preparing feasibility studies on construction of coal processing plants.
- Should have analytical, problem solving and decision making skills, and should be able to demonstrate leadership skills on day-to-day operation of a team that is comprised of multinational professionals.
- Should have very good command of written and spoken English.

**Financial and economic research team leader is expected to meet following criteria:**
- Should hold a professional degree (Masters or above) in Project Financing and Financial Management.
- Should have at least 10-years of work experience in his/her professional field and have held a management level position for more than 5 years, and have experience in team management.
- Should have employment experience in financial institutions.
- Should have analytical, problem solving and decision making skills, and should be able to organize a team that is comprised of multinational professionals and be able to provide fast and flexible cooperation.
- Should have very good command of written and spoken English.

**Technical research team leader is expected to meet following criteria:**
- Should hold relevant engineering degree (Master or higher)
- Should have at least 10-years of work experience in his/her professional field and should have held management level position for than 5 years, and should have experience in project
management, leading a project on preparing feasibility studies on construction of coal processing plants.

- Should have analytical, problem solving and decision making skills, and should be able to organize a team that is comprised of multi-national professionals and be able to provide fast and flexible cooperation.

- Should have very good command of written and spoken English.

Chemical Technology engineer is expected to meet following criteria:

- Should hold a Bachelors’ or above professional degree in Chemistry and engineering with professional training in coal chemistry.

- Should have at least 10-years of work experience in his/her professional field and have employment experience in projects on preparing feasibility studies on construction of coal processing plants.

- Should be able to collect information from various different sources, and be able to synthesize the information.

- Should be able to accomplish a due task on time with high quality, and be able to work independently and efficiently, and should have skills to work with international professionals a team.

Economic and financial expert is expected to meet following criteria:

- Should hold a bachelor’s or above professional degree in Economics, Finance and Industrial Management, and should have a professional training in one of the following areas: project management, strategic planning, urban planning, and project investment.

- Should have employment experience of more than 10 years in his/her professional field, and should have experience in conducting project investment calculation, economic analysis and project revenue estimation for at least 3 projects.

- Should be able to collect information from various different sources, and be able to synthesize the information.

- Should be able to accomplish a due task on time with high quality, and be able to work independently and efficiently, and should have skills to work with international professionals a team.

5.4. Payment Schedule

Work schedule and plan: An advance of 10% of the total payment will be paid upon submission of Work schedule and plan prepared in dual language – English and Mongolian, 30 days after the receipt of official letter awarding the contract.

Interim report on preliminary research: After submission of the interim report on preliminary research to the PIU, another 25% of the total payment will be made.

Final report on preliminary research: After receiving comments made by the PIU on final report on preliminary research, and review of the report by the Client, and discussion of the
report by Science and Technology Committee of Ministry of Energy, another 30% of the total payment will be made as the report has satisfactorily addressed all comments.

**Final report on completed feasibility study:** The remaining 35% of the total payment will be made upon approval of the final report on completed feasibility study by Science and Technology Committee of Ministry of Energy after integrating comments made during Client and PIU meetings and an expertise review.