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**ASIAN INFRASTRUCTURE
INVESTMENT BANK**

PD000323-CHN
December 12, 2019

**Project Document
of the Asian Infrastructure Investment Bank
Sovereign-backed Financings**

People's Republic of China

**Beijing-Tianjin-Hebei Low Carbon Energy Transition and Air Quality
Improvement Project**

Currency Equivalents

(as of 23 September 2019, People's Bank of China)
Currency unit – Chinese Yuan (CNY)

CNY1.00 = USD0.1424

USD1.00 = CNY7.0734

Borrower's Fiscal year

January 1 – December 31

Abbreviations

AIIB	–	Asian Infrastructure Investment Bank
BTH	–	Beijing, Tianjin and Hebei
CO ₂	–	carbon dioxide
COD	–	commercial operation day
ERP	–	enterprise resource planning
ESP	–	Environmental and Social Policy
ESIA	–	Environmental and Social Impact Assessment
ESMP	–	Environmental and Social Management Plan
ESS	–	Environment and Social Standard
FM	–	financial management
FY	–	fiscal year
GDP	–	gross domestic product
GRM	–	Grievance Redress Mechanism
GW	–	gigawatt
IE	–	implementation entity
IEA	–	International Energy Agency
km	–	kilometer
LNG	–	liquefied natural gas
NO _x	–	nitrogen oxides
O&M	–	operation and maintenance
OECD	–	Economic Co-operation and Development
PIR	–	Procurement Instructions for Recipients
PM	–	particulate matters
PMO	–	project management office
RAP	–	Resettlement Action Plan
SO ₂	–	Sulphur dioxide

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1. Summary Sheet

People's Republic of China Beijing-Tianjin-Hebei Low Carbon Energy Transition and Air Quality Improvement Project

Project No.	000323
Borrower	People's Republic of China
Project Implementation Entity	Beijing Municipality and Beijing Gas Group Company Limited (Beijing Gas)
Sector Subsector	Energy Gas processing, transmission and distribution
Project Objective	The objective of the proposed Project is to increase the availability of natural gas to help reduce coal consumption and related emissions in the region of Beijing, Tianjin and Hebei (the BTH region). The proposed Project is in line with China's endeavor to transition to a lower carbon energy supply structure. Upon completion, it will help improve air quality by reducing a significant amount of coal combustion-related emissions such as CO ₂ , SO ₂ , NO _x and particulate matters in the BTH region.
Project Description	<p>The proposed Project is to construct a liquefied natural gas (LNG) terminal in Binhai District, Tianjin Municipality, which includes two components.</p> <ul style="list-style-type: none"> • Component One: construction of LNG receiving, storage and regasification facilities with an annual handling capacity of 5 million tons of LNG. • Component Two: construction of unloading wharf. <p>AIIB financing is planned to be used in the construction of LNG receiving, storage and regasification facilities under Component One.</p>
Implementation Period	Start Date: December 2019 End Date: December 2024
Expected Loan Closing Date	June 30, 2025
Cost and Financing Plan	Project cost: USD1,905.2 million Financing Plan: AIIB loan: USD 500.0 million Beijing Municipal Government: USD571.6 million Beijing Gas: USD833.6 million
Size and Terms of AIIB Loan	USD 500 million, with a maturity of 20 years, including a grace period of 5 years, at AIIB's standard interest rate for sovereign-backed variable spread loans with the corresponding weighted average maturity.
Cofinancing	N/A

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(Size and Terms)	
Environmental and Social Category	Category A
Risk (Low/Medium/High)	High
Conditions for Effectiveness	Signing of subsidiary loan agreement acceptable to AIIB.
Key Covenants/Conditions for Disbursement	The Project Implementation Entity shall carry out the Project in accordance with AIIB's Environmental and Social Policy and Standards. The Implementation entity shall ensure that the Project implementation comply with all measures and requirements set forth in the agreed environmental and social documentation for the Project and associated facilities, and any corrective or preventative actions required.
Retroactive Financing (Loan % and dates)	Retroactive financing will be up to 20 percent of the loan amount to finance expenditures incurred not earlier than 12 months before the signing date of the loan agreement.
Policy Assurance	The Vice President, Policy and Strategy, confirms an overall assurance that the Bank is in compliance with the policies applicable to the Project.

President	Jin Liquan
Vice President, CIO	D.J. Pandian
Director General, IO II	Yee Ean Pang
Manager	Rajat Misra
Team Leader	Hongliang Yang, Principal Investment Operations Specialist
Team Members	Chongwu Sun, Senior Environmental Specialist David Morgado, Senior Energy Policy Specialist Haiyan Wang, Senior Finance Officer Julius Thaler, Senior Counsel Noureddine Berrah, Economic Advisor Somnath Basu, Principal Social Development Specialist Yaxin Yan, Young Professional Yan Li, Senior Economist Yi Geng, Senior Financial Management Specialist Youxuan Zhu, Senior Social Development Specialist Xiaowei Guo, Senior Procurement Specialist Kunyuanyuan Hu, Project Assistant

2. Project Description

A. Rationale

1. **Country Priority.** China is in the process of energy transition with an aim to develop a “clean, low carbon, safe and efficient” energy system.¹ China’s economic performance over the past three decades has been remarkable by any standard. It is now the largest exporter and manufacturer, and the second largest economy in the world. Due to its resource-intensive growth model in the past, China is now experiencing daunting environmental damage, which was estimated to cost between 3 percent and 10 percent of its gross domestic product (GDP),² of which a substantial share comes from air pollution. Concerned that the old and outdated model is unsustainable, the Government of China proposed *green development* in its 12th Five Year Plan (2011-2015), which is a pattern of development that decouples growth from excess resource use, high carbon emissions and serious environmental damage. Since then, green development has been made a top priority in China’s development policy making. For example, in 2012 the Government issued new ambient air quality standards to limit the concentrations of six major atmospheric pollutants.³ In 2013, it launched a nationwide Comprehensive Action Plan for Air Pollution Prevention and Control (2013-2017).⁴ In 2016, the Thirteenth Five-Year Plan (2016–2020) began to impose mandatory targets for local air quality improvement.⁵ In 2018, the Government announced its Three-year Action Plan to Win the Blue-Sky Defense War.

2. Reducing coal consumption is now at the center of China’s green development agenda. Due to its natural resource constraints, China has been heavily dependent on coal to fuel its economic growth. Pollutants from coal combustion have been a major source of air pollution and the fifth largest cause of premature deaths in the country.⁶ In 2018, the Government required local governments to make further efforts on air pollution control, and strictly control the total consumption of coal and orderly eliminate inefficient coal-fired power plants and small coal-fired boilers in three key areas,⁷ and use natural gas and electricity to replace coal for heating in winter in north China.⁸

¹ Xi Jinping, 2017. Secure a Decisive Victory in Building a Moderately Prosperous Society in All Respects and Strive for the Great Success of Socialism with Chinese Characteristics for a New Era.

² China 2030: Building a Modern, Harmonious, and Creative Society. World Bank and the Development Research Center of the State Council, the People’s Republic of China. China’s Ministry of Environmental Protection estimates the cost of pollution at around 1.5 trillion CNY (about US \$215 billion using current exchange rate), or roughly 3.5 percent of GDP, according to 2010 figures.

³ The six atmospheric pollutants include: sulfur dioxide (SO₂), nitrogen oxide (NO_x), carbon monoxide (CO), ozone, particulate matter less than 2.5 microns in diameter (PM_{2.5}), and 10 microns or less in diameter (PM₁₀).

⁴ The policy outlined the most stringent air pollution control measures in China’s history.

⁵ The Thirteenth Five-Year Plan requires: (i) > 80% days with good air quality (less than 100 per air quality indicator) per annum for cities at or above prefecture level, and (ii) 18% reduction in number of cities that do not meet the PM_{2.5} national standard. Source: Government of the PRC. 2016. *Thirteenth Five-Year Plan, 2016–2020*. Beijing.

⁶ Health Effects Institute and Tsinghua University, 2016. Air Pollution from Coal: A Major Source of Health Burden in China. Boston.

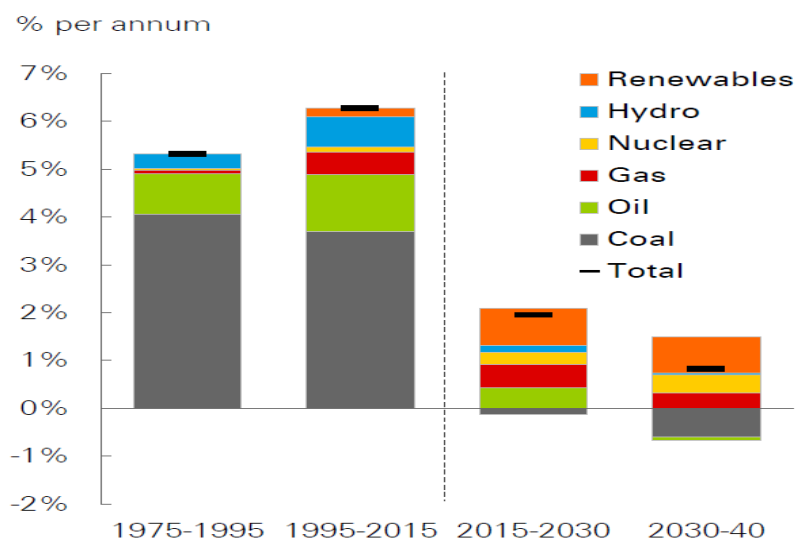
⁷ The three key areas mentioned in the policy include: the Beijing-Tianjin-Hebei region (BTH region) and surrounding provinces, the Yantze River Delta, and the Fenhe and Weihe Plain region.

⁸ State Council, 2018. *Three-year Action Plan to Win the Blue-Sky Defense War*.

With strong interventions, air quality over the last few years has generally improved, but the absolute level of air pollution remains high compared to the Organization for Economic Co-operation and Development’s (OECD) member countries.

3. China’s endeavor to reduce coal consumption and improve air quality is compliant with China’s commitment to peak its carbon dioxide (CO₂) emissions by 2030 under the Paris Agreement. Since coal combustion is the single-largest source for both air pollution and CO₂ emissions in China, with increasing public awareness of environmental protection and frequently declared air pollution emergencies, it has become a common understanding that China needs to change its energy supply mix, reducing coal consumption, and transit to a more sustainable low-carbon development path. Recent studies show that the total energy demand in China is close to peaking with an annual growth rate of just 1.5 percent from now to 2040.^{9,10} Driven by its shifting economic structure and its commitment to improve air quality, cumulative evidence indicates that *China’s consumption of coal has peaked*.¹¹ On the contrary, renewable energy, together with nuclear and hydro, will account for over 80 percent of the primary energy growth for the period up to 2040. Natural gas is also expected to play an active role in China’s low carbon energy transition (Figure 1). The proposed Project is in line with China’s low carbon energy transition trend and the Government’s policy priorities to reduce coal consumption and improve regional air quality. Given its foreseeable environmental benefits, the proposed Project has been strongly supported by the Government.

Figure 1: China’s Low Carbon Energy Transition Projection till 2040: Annual energy growth and contributions by sources



Source: BP Energy Outlook 2018

⁹ China Social Science Academy, 2018. China Energy Outlook (2018-2050).

¹⁰ BP Energy Outlook, 2018.

¹¹ BP Energy Outlook, 2018.

4. **Institutional Context.** According to the International Energy Agency (IEA), natural gas has a central role in the global energy transition. Above all, compared to coal, natural gas on average emits 40 percent less carbon emissions per unit of energy output and 50 percent less carbon emissions per unit of electricity generated.¹² Using natural gas to replace coal can significantly reduce carbon emissions and air pollution.¹³ Also, the global economy will increasingly depend on reliable, affordable and sustainable energy supply. Despite their growing role in energy supply, renewables cannot meet the global energy demand so far, particularly in the industrial and building sectors. Natural gas is an abundant, secure and clean source of energy, which can be used across all sectors in the economy. Moreover, natural gas supports the integration of intermittent renewables into the electricity network as modern gas-fired generators can quickly be put into operation and rapidly respond to sudden increases in demand or sudden dips in solar or wind power.^{14, 15} In 2018 the total generating capacity in China was about 1,900.1 gigawatt (GW), of which solar capacity was around 174.3 GW and wind capacity was around 184.3 GW.¹⁶ There is an increasing need for reserve capacity backed up by natural gas in the power system. Therefore, using natural gas to replace coal will not only help humanity fuel economic growth while lowering carbon emissions and improving air quality, but also win precious time to develop more reliable and more cost-effective next-generation renewable technologies.

5. Natural gas enjoys strong development momentum worldwide and in China. Natural gas currently accounts for about 27 percent of the total energy supply in OECD countries and 22 percent worldwide. It will soon overtake coal as the second-largest energy resource.^{17,18} As per IEA, the use of natural gas would increase by 45 percent from 2017 to 2040, of which a large part of that growth is expected to be from developing countries.¹⁹ Compared to OECD countries and even the world average, China lags far behind in natural gas consumption. In 2018, natural gas was only about 7 percent of total energy consumption in China. The Government of China has taken measures to boost domestic gas production and import gas from abroad.²⁰ Driven by its continuous economic growth and strong policy support to curb air pollution, China has become one of the major natural gas importers in the world. In 2018 China imported about 90.39 million tons of natural gas, representing an increase of 31.8 percent compared to 2017, of which liquefied natural gas (LNG) dominates. In tandem with the increasing LNG import comes the growing handling capacity of LNG terminals in China. In 2018, the annual handling capacity of LNG terminals in China reached 66.95 million tons. China has also expanded its gas pipeline networks. In 2018, the total length of

¹² International Energy Agency (IEA), 2019. The Role of Gas in Today's Energy Transitions.

¹³ Shell, Natural Gas: Providing More and Cleaner Energy.

¹⁴ IRENA, Planning for the Renewable Future, 2017.

¹⁵ IEA, The Role of Gas in Today's Energy Transitions, 2019.

¹⁶ China Electricity Council, 2019. China Electricity Industry Annual Development Report (2019).

¹⁷ BP Energy Outlook, 2017.

¹⁸ IEA, World Energy Outlook, 2018

¹⁹ IEA, World Energy Outlook, 2018

²⁰ State Council, 2014. Notification for Establishing the Long-term Mechanism to Secure Natural Gas Supply. General Office, 2014 (16).

gas pipeline reached 76,000 kilometers (km).²¹ The Government planned to connect all Chinese cities with a population of half a million by gas pipeline by 2025.²²

6. **The BTH region.** The BTH region is one of the most important economic engines in China and has been facing the dual challenges of ensuring energy supply and addressing air pollution. In 2017 the BTH region, with a total population of about 112.5 million and a share of about 10 percent of the national GDP, consumed around 450 million tons of standard coal equivalent, of which around 50 percent was covered by coal.²³ The BTH region, particularly Hebei and Tianjin, consistently experiences poor air quality mainly due to an excessive reliance on coal and insufficient environmental protection measures. After years' endeavor to improve air quality, the share of coal to total energy consumption in Beijing was already reduced to about 5.0 percent in 2017. However, in 2017 the shares of coal in Tianjin and Hebei were still around 34.6 percent and 64.4 percent, respectively. This can probably explain why the absolute level of air pollution remains high in the BTH region. For example, the BTH region's annual average concentration of PM_{2.5} was about 53 microgram per cubic meter ($\mu\text{g}/\text{m}^3$) in 2018, representing an approximately 17 percent progress compared to 2017, but still far below the World Health Organization's standard (i.e. annual mean not exceeding 10 $\mu\text{g}/\text{m}^3$).²⁴

7. Concerted and comprehensive approaches are needed to address air pollution in the BTH region, since it is a complicated cross-industry and transboundary issue. During the 12th Five Year Plan period (2011-2015), local governments in the BTH region promulgated many policies and measures for air pollution control, of which one important measure is to replace coal with natural gas. During this period, in Beijing alone, several coal-fired power plants were closed, more than 200,000 tons/hour coal-fired boilers were converted into gas-fired boilers, and more than 200,000 gas connections were installed. Since the costs and the financial returns of connecting rural households were very challenging, most of the coal-to-gas switching during the period was done in urban areas in the BTH region. However, as rural loose coal normally contains higher quantities of sulphur, nitrogen and ash than the more refined coal available to large scale industrial users, which also have air quality control systems, a very recent IEA report showed that although this lower quality coal accounts for only 10 percent of total coal consumption, it is responsible for half of air pollutant emissions in north China.²⁵ This implies a greater urgency in effecting a switch away from coal in rural areas. The *BTH Region Coordinated Development Plan on Energy (2017-2020)* required local governments to promote green development, reduce coal consumption, and speed up the low-carbon energy transition, with specified coal reduction targets. For instance, it required, by 2020 in Beijing Municipality coal to be eliminated in the

²¹ China Industrial Information, 2019. Chinese Natural Gas Network Development: Status Quo and Future Outlook. Access at <http://www.chyxx.com/industry/201904/729069.html> on August 20, 2019.

²² National Development and Reform Commission, 2017. National Medium- and Long-Term Development Plan for Natural Gas Pipeline Network.

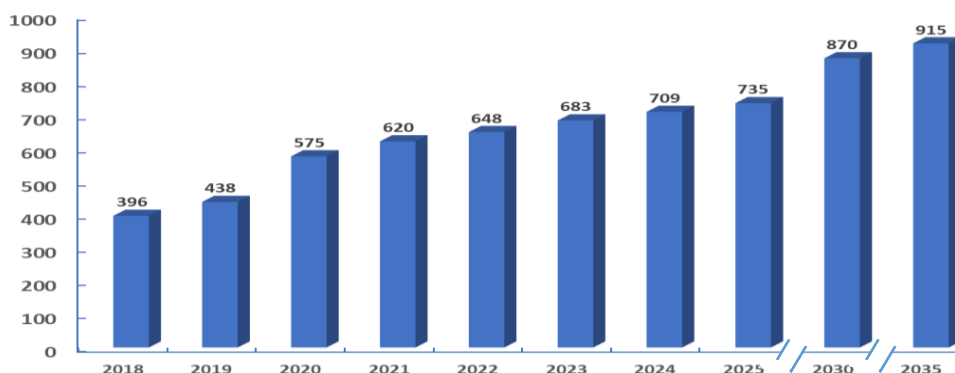
²³ China Energy Statistics Yearbook, 2018.

²⁴ World Health Organization, 2019. Ambient (outdoor) air quality and health. Access at: [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)

²⁵ IEA, 2019. The Role of Gas in Today's Energy Transitions. Paris, France.

plain areas; in Tianjin Municipality coal for heating to be eliminated in the plain areas, though anthracite might still be used for heating in mountainous areas based on local condition; and in Hebei Province coal for heating to be eliminated in the plain areas. These targets will not be possible without sufficient natural gas supply in the region. To meet the increasing demand, the Government has approved a list of gas projects. Figure 2 shows the growing trend of natural gas demand in the BTH region.

Figure 2: Natural Gas Demand Projection in the BTH Region²⁶
(unit: 100 million m³)



Source: Beijing Gas Estimate.

8. **Need for Gas Emergency Reserve.** Driven by the coal-to-gas switching and increased demand for heating during the unexpected harsh winter of 2017/18, the seasonal gas demand reached a record high level, which was compounded by insufficient storage and LNG regasification capacity, shortfalls in piped imports and internal infrastructure bottlenecks. It was estimated that during December 2017 the daily supply shortage in China was around 69 million cubic meters, of which around 30 million cubic meters were in the BTH region. Many households in north China, particularly in rural areas, were forced to go back to coal-fired stoves for heating. Taking this lesson learned, the National Development and Reform Commission and National Energy Administration in April 2018 issued a joint administrative decree requiring local governments and gas companies to build their own gas supply emergency reserve capacity to maintain people’s livelihood when and as needed. Besides financing LNG unloading and regasification facilities, the proposed Project also includes the construction of 10 LNG storage tanks with a volume of no less than 200,000 cubic meters each, which can be a useful buffer in time of need for the BTH region.

9. **Development Coordination.** Multilateral Development Banks have been providing financial assistance to the BTH region to help address air pollution issue.²⁷

²⁶ Beijing Gas estimates.

²⁷ ADB, 2016. *Report and Recommendation of the President to the Board of Directors: Proposed Loan for Air Quality Improvement in the Greater Beijing–Tianjin–Hebei Region —China National Investment and Guaranty Corporation’s Green Financing Platform Project*. Manila.

World Bank, 2016. *Proposed Loan for Hebei Air Pollution Prevention and Control Program*. Washington DC, US.

For instance, the World Bank recently approved two program-for-results loans, “*the Innovative Financing for Air Pollution Control in Jing-Jin-Ji*”²⁸ and “*Hebei Air Pollution Prevention and Control Program*”,²⁹ of **USD500 million each**, to reduce air pollution and carbon emissions through strengthening a commercial bank’s capacity in making energy efficiency lending and through supporting a broad multisectoral Hebei government’s Action Plan, respectively. Besides, some other projects, which did not specifically include air pollution control in their project titles, may also have air pollution control benefits in the BTH region.³⁰ Under the common name of *Air Quality Improvement in the Greater BTH Region*, Asian Development Bank (ADB) approved four loans across sectors in different provinces.³¹ The first loan of **USD300.0 million**, approved in 2015, focused on policy reforms and regulatory capacity building in Hebei Province. The second loan of **USD499.6 million**, approved in 2016, targeted better access to finance, especially for small- and medium-sized enterprises, to scale up investments in pollution reduction projects in the BTH region. The third loan of **USD499.0 million**, approved in 2017, aimed to deploy advanced technologies to reduce air pollution from large emitters in the agriculture, energy, transport and urban sectors. The fourth loan of **USD499.9 million** was to help Shandong Province make its heating and cooling systems cleaner and more efficient. The proposed Project will complement the previous projects financed by World Bank and ADB by improving the energy supply structure and reducing coal consumption in the BTH region. This will generate direct benefits of carbon emissions reduction and air quality improvement.

10. **Previous Investment in Air Quality Improvement.** On December 8, 2017, AIIB’s Board of Directors approved a non-sovereign-backed loan of USD250 million to Beijing Gas Group Company Limited (Beijing Gas) to support a coal-to-gas switching project outside the urban areas of Beijing.³² As a part of a broad Clean Air Action Plan in Beijing, which has been implemented since 2015, the coal-to-gas switching project was designed to provide natural gas connections to 216,751 rural households, including the installation of small low-pressure village gas pipelines, household connections and gas consumption meters, within the boundaries of approximately 510 rural villages. The loan agreement between AIIB and Beijing Gas was signed on March 19, 2018. Since then, the coal-to-gas switching project has been implemented smoothly. As of end 2018, the coal-to-gas switching project already connected 176,000 rural households. Assuming that each household on average consumes 3.0 tons of coal per heating season, the coal-to-gas switching project has already reduced annually coal consumption by 528,000 tons. This brought substantial environmental benefits per year, including reduction of CO₂ of 483,890 tons, PM of 3,006 tons, SO₂ of 1,209 tons, and NO_x of 3,608 tons, outside the urban areas of Beijing.³³

²⁸ Jing-Jin-Ji is the abbreviation of Beijing-Tianjin-Hebei (the BTH region) in Chinese Pingyin.

²⁹ http://projects.worldbank.org/search?lang=en&searchTerm=&countrycode_exact=CN

³⁰ For example, the Hebei Clean Heating Project (approved in 2016). Access at: <http://projects.worldbank.org/P148599?lang=en>

³¹ For details, please refer to: <https://www.adb.org/projects/country/prc/sector/energy-1059>

³² AIIB, 2017. Beijing Air Quality Improvement and Coal Replacement Project.

³³ ‘Beijing Gas makes full efforts to implement clean air action and win the blue-sky defense war’. Access at <http://www.bjgas.com/news.aspx?id=6796> on Nov. 19, 2019.

11. **Relation to Country Priorities.** The proposed Project is in line with the national and regional energy sector development and environment protection plans. Due to its natural resource constraints, China has been heavily dependent on coal to fuel its economic growth. Coal combustion is the single-largest source for both air pollution and CO₂ emissions. Therefore, reducing coal consumption is now a top priority under both air quality and climate change policy goals in China. The BTH region is one of the most important economic engines in China. Since the region is heavily dependent on coal, it consistently tops country rankings for the highest concentration of PM_{2.5} and other air pollutants. Upon completion, the proposed Project is expected to bring substantial environmental benefits in air quality improvement and carbon emissions reduction.

12. **Strategic fit for AIIB.** The proposed Project is aligned with AIIB's strategic priorities in terms of sustainable infrastructure and its Energy Sector Strategy in terms of promoting access to clean energy and supply security, reducing the carbon intensity of energy supply, managing local and regional pollution and promoting regional cooperation and connectivity. Upon completion, the proposed Project will increase the availability of natural gas and help reduce coal consumption in the BTH region, thereby reducing coal combustion related emissions such as CO₂, SO₂, NO_x and PM.

13. **Value addition by AIIB.** The proposed Project will promote low carbon development and create substantial environmental and social benefits in the BTH region. Firstly, by working with the Bank and following the Bank's Environmental and Social Policy, the implementation entity (IE) will strengthen its capacity in preparing and implementing major infrastructure projects in line with the international good practice in the gas sector. Secondly, due to the Bank's participation, international open competitive tendering will be applied. This will increase the competition level of the Project tendering and lead to a more cost-effective result. Thirdly, the proposed Project will support China's efforts to fulfill its commitments under the Paris Agreement, and will strengthen and contribute to the global response to the threat of climate change. Last, but not the least, AIIB's long-term financing support will help the IE reduce the Project's financing uncertainty and improve its financial viability.

14. **Value addition to AIIB.** The proposed Project will be the first LNG unloading, storage and regasification project financed by the Bank. Firstly, through the proposed Project, the Bank can build up its own institutional capacity and expertise in LNG infrastructure. Lessons learned can later be used in similar LNG projects in other less developed countries, such as Bangladesh and Pakistan, where constructing LNG receiving facilities has gradually become a necessary and cost-effective solution to their energy supply issues. Secondly, according to the World Health Organization, people living in low- and middle-income countries disproportionately (about 91 percent in 2016) experience the burden of outdoor air pollution and are therefore eager to find efficient and cost-effective solutions.³⁴ Since the proposed Project is going to bring significant environmental benefits, it will be a very good example for the Bank to

³⁴ World Health Organization, 2018. Air Pollution. Access on October 15, 2019 at: [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health).

showcase how its developing members could reduce air pollution and carbon emissions by transferring to a low carbon development path, which was promoted under the Paris Agreement. This will help the Bank strengthen its “green” agenda in the field of low-carbon development and air quality improvement.

B. Project Objective and Expected Results

15. **Project Objective.** The objective of the proposed Project is to increase the availability of natural gas to help reduce coal consumption and related emissions in the BTH region. The proposed Project is in line with China’s endeavor to transition to a lower carbon energy supply structure. Upon completion, it will help improve air quality by reducing a significant amount of coal combustion-related emissions such as CO₂, SO₂, NO_x and particulate matters in the BTH region.

16. **Expected Results.** The expected results of the proposed Project can be measured using the following key performance indicators (Annex 1):

- (i) Increase in LNG unloading capacity (tons);
- (ii) Annual coal consumption avoided (tons);
- (iii) Annual CO₂ avoided (tons);
- (iv) Annual PM avoided (tons);
- (v) Annual SO₂ avoided (tons); and
- (vi) Annual NO_x avoided (tons).

17. **Expected Beneficiaries.** When in full operation, the proposed Project is expected to bring substantial environmental benefits in the avoidance of CO₂, SO₂, NO_x and PM. Table 1 exhibits the avoided emissions as a result of the proposed Project. Measured in heat value, with the Project annually 5.0 million tons of LNG will replace approximately 11.9 million tons of coal³⁵ in the BTH region. Correspondingly, it will generate substantial positive long-term environmental and social impacts. The ambient air quality and the environment in the BTH region will improve once coal consumption is reduced, thus reducing the risk of respiratory, cardiovascular and ischemic heart diseases.³⁶ Those most vulnerable to these impacts, such as children, the poor, the sick and the elderly, will benefit the most.

Table 1: Avoided Emissions as A Result of the Project

		Without Project	With Project	Avoided
	Type	Ordinary coal	LNG	
Fuel	Heat content	5,000 kcal/kg	35.91 MJ/m ³	
	[million ton]	11.90	5.0	
SO ₂	[ton]	27,225	-	27,225
PM	[ton]	67,000	-	67,000
NO _x	[ton]	90,927	12,486	78,441

³⁵ For calculation, the calorific value of coal is assumed at 5,000 kcal/kg.

³⁶ Health Effects Institute and Tsinghua University. 2016. *New Study: Air Pollution from Coal a Major Source of Health Burden in China*. Boston.

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		Without Project	With Project	Avoided
Total local pollutants	[ton]	185,152	12,486	172,666
CO ₂	[million tCO ₂]	21.34	13.83	7.50

C. Description and Components

18. The proposed Project is to construct a LNG terminal in Binhai District, Tianjin Municipality, which includes two components. Upon completion, the proposed Project will be able to supply 60 million cubic meters of natural gas daily into the BTH region.

- **Component One: construction of LNG receiving, storage and regasification facilities.** Proposed activities under Component One include the construction of LNG receiving facility with an annual handling capacity of 5 million tons of LNG, 10 LNG storage tanks with a volume of no less than 200,000 cubic meters each, and regasification facility with a maximum daily operating capacity of 60 million cubic meters of natural gas.
- **Component Two: construction of unloading wharf.** Proposed activities under Component Two include the construction of a working platform, 4 mooring dolphins and 6 mooring cleats.

19. AIIB financing is planned to be used in the construction of LNG receiving, storage and regasification facilities under Component One.

D. Cost and Financing Plan

20. The cost estimate of the proposed Project is about USD1,905.21 million (CNY13,476.33 million) (Table 2).

Table 2: Cost Estimate and Financing Plan

No.	Cost Item	AIIB		Beijing Municipal Government		Beijing Gas		Total Cost (USD million)
		Amount	%	Amount	%	Amount	%	
1	Construction Costs							
1.1	LNG receiving facility	498.75	41.2	500	41.3	212.66	17.6	1211.41
1.2	Unloading wharf			71.56	30.6	161.96	69.4	233.52
1.3	Other expenses					239.61	100	239.61
2	Contingency					121.72	100	121.72
3	Financing Charges during Construction	1.25	1.3			94.76	98.7	96.01
4	Initial working capital					2.95	100	2.95
	Total (1+2+3+4)	500	26.2	571.56	30	833.65	43.8	1905.21

21. The AIIB loan of USD500 million is proposed to have a 20-year term, including a grace period of 5 years, at AIIB's standard interest rate for sovereign-backed variable

spread loans with the corresponding weighted average maturity. The loan will be made to the People’s Republic of China, which will be onlent by the Government of China to the Project’s IE, Beijing Gas, through the Beijing Municipal Government on the same terms and conditions as the Loan, under a subsidiary loan agreement acceptable to the Bank.

22. With environmental pressures mounting, especially due to air pollution, the Beijing Municipal Government is increasing its financial support to steer the city’s energy mix away from coal. The Beijing Municipal Government will, as per its own issued policy, provide a grant equivalent to 30 percent of the Project’s investment costs, or around USD 571.56 million according to the Project’s cost estimate. The balance of the Project’s investment costs will be covered by Beijing Gas’ equity investment and borrowing from other financiers.

E. Implementation Arrangements

23. The planned implementation arrangements are summarized in Table 3.

Table 3: Implementation Arrangements

Aspects	Arrangements
Project implementation period	December 2019 – December 2024
Expected completion date	December 31, 2024
Loan closing date	June 30, 2025
Project Management	
(i) Implementation entities (IE)	Beijing Municipality and Beijing Gas Group Company Ltd. (Beijing Gas)
(ii) Project Management Office (PMO)	Established
Procurement: goods and works	International open competitive tendering for all contracts financed by AIIB.
Retroactive financing and advance contracting	Eligible contracts and expenditures, up to 20 percent of the loan amount, incurred not earlier than 12 months before the signing of the loan agreement, will be considered for retroactive financing.
Disbursement	The loan proceeds will be disbursed in accordance with the Bank’s loan disbursement instructions and detailed arrangements agreed upon between the IE and the Bank.

24. **Monitoring and Evaluation.** Beijing Gas has a well-developed corporate structure with clearly defined roles and responsibilities for all project-related tasks. This structure has proven to be effective, as evidenced by its track record in implementing large gas transmission and distribution projects in the past. The implementation arrangements for the proposed Project will make best use of Beijing Gas’ existing project management and monitoring systems. Beijing Gas will submit periodically to AIIB Project monitoring reports, whose contents should cover all essential aspects of Project implementation, including contract awards, disbursements, physical progress, compliance of environmental and social safeguard requirements, key implementation issues and solutions, updated implementation and procurement plans for next 12

months, and a project completion report within six months after the closing date of the proposed Project. The Finance Department and PMO will be the key interfaces between Beijing Gas and AIIB. Beijing Gas has assigned one environmental officer and one social officer responsible for monitoring environmental and social related matters. AIIB will discuss and agree with Beijing Gas on the Project's monitoring and supervision plans before the implementation of the proposed Project starts.

25. **Implementation Support.** AIIB will conduct project implementation support missions on a regular basis. In case of any compliance discrepancy identified during project implementation, a corrective plan will be developed and implemented.

26. **Procurement.** AIIB's Procurement Policy (dated January 2016) and its associated Interim Operational Directive on Procurement Instructions for Recipients (PIR, dated June 2, 2016) shall apply to the procurement of all contracts funded in whole or in part by AIIB under the Project for procurement purpose. Beijing Gas is responsible for implementing the Project, including all aspects of the procurement process from the planning and tendering stages through to contract award and supervision of contract implementation. Since AIIB's loan will be extended to the People's Republic of China and onlent by the Government to Beijing Gas, for procurement purposes, the provisions of the Section II of PIR apply to all Bank-financed contracts procurement. A Project Delivery Strategy including a detailed procurement plan has been developed by Beijing Gas, in which the procurement method and contract packaging have been determined. Two engineering-procurement-construction (EPC) contracts are planned to be financed by AIIB – one is for the construction of LNG Storage Tanks, and the other is for the construction of LNG receiving and regasification facilities. International Open Competitive Tendering will be followed to ensure no restriction upon the procurement from any country. An updated multilateral development bank's tender document to meet the Bank's requirements with the FIDIC's "Condition of Contract for EPC/Turkey Projects" will be used.³⁷ This approach has proven technically successful in the recent projects implemented by other Chinese and international companies, since the construction of various components of LNG storage tanks and related equipment can be better coordinated by a single EPC contractor. This will reduce the Project's construction risks and Beijing Gas' workload to coordinate and manage multiple contractors, while meeting the construction deadlines and budget control targets. The Bank will conduct prior review on the two EPC contracts and supervise the procurement activities accordingly. Eligible expenditures under the contracts financed by AIIB will be considered for advance contracting and retroactive financing. In such cases, the procurement procedures, including advertising, shall be consistent with AIIB's PIR.

27. **Disbursement.** The loan proceeds will be disbursed in accordance with AIIB's loan disbursement instructions. Multiple disbursement methods will be provided to accommodate the needs of the proposed Project, such as direct payment, advance

³⁷ FIDIC is a French language acronym for Fédération Internationale Des Ingénieurs-Conseils, which means the international federation of consulting engineers. FIDIC is headquartered in Switzerland and now boasts of membership from over 60 different countries.

payment, reimbursement (contract-based) and special commitment method, if needed. The Government of China and Beijing Gas will ensure that all expenditures financed out of the loan proceeds are used exclusively in carrying out the proposed Project and will exercise its rights in such manner as to protect its interests and those of AIIB and to accomplish the purposes of the loan. Before the submission of the first withdrawal application, the Government of China should submit to AIIB sufficient evidence of the authority of the person(s) who will sign the withdrawal applications on behalf of the Government, together with the authenticated specimen signatures of each authorized person.

28. **Financial Management (FM).** The proposed Project will use Beijing Gas' existing enterprise resource planning (ERP) system in budgeting, treasury payment, accounting and financial reporting. A Project financial team has been established in the PMO with three members, and more staff will be equipped during Project implementation to conduct financial management work, such as accounting, financial reporting, payment processing, budget preparation and execution, disbursement preparation, internal inspection and management control. The finance team in the headquarter of Beijing Gas will be responsible for mobilizing counterpart funds including company's own funds, government grant, other financiers' funds and commercial loans. Project financial statements will be prepared in a timely manner to reflect sources and usage of project implementation status. Project audit will be conducted annually by the National Audit Office or its local branch, and such audit report will be submitted to the Bank within 6 months after the end of each year. These will ensure proper usage of project funds.

3. Project Assessment

A. Technical

29. The proposed Project presents no significant technical risk. Technical due diligence was conducted based on: (i) Project proposal and feasibility study, (ii) study on natural gas demand growth in the BTH region; (iii) desk review on international LNG supply; (iv) discussions with engineers preparing the Project feasibility study, and (v) project site visits conducted during July-October 2019. Beijing Gas has a proven track record in financing and implementing large gas supply projects. It is currently the largest gas supplier for a single city in Asia and the second largest worldwide, leading the industry in terms of the scale of its pipeline network, number of consumers and annual gas sales. Its pipeline network covers all six central districts and most suburban districts of Beijing.

30. The LNG unloading facility, storage tanks and regasification facility to be built under the proposed Project are decided against the forecasted demand in the BTH region, and compatible with national and international good practices. The Project has passed several rounds of expert review organized by different governmental agencies, including the National Development and Reform Commission, National Energy Administration and Ministry of Ecology and Environment as per their respective procedures.

B. Economic and Financial Analysis

31. **Economic Analysis.** A cost-benefit analysis was carried out to assess the economic viability of the proposed Project on a with- and without-project basis. The costs associated with the Project include (i) the investment costs of the LNG receiving and processing facilities to be constructed under the Project; (ii) the costs of LNG import; (iii) the costs of operation and maintenance of the receiving, storage and regasification facility constructed under the Project; (iv) the transportation costs of natural gas to Beijing, including a separate investment in a natural gas pipeline and the costs of operating and maintaining the pipeline. The benefits of the Project include (i) direct benefit from gas sales; (ii) positive local externalities of avoided local air pollutants; and (iii) positive global externality of avoided CO₂ emissions.

32. *Outcome of the economic analysis.* With a project lifetime of 27 years, inclusive of a 6-year construction period and a 21-year operational life, the Project investment yields an estimated economic internal rate of return (EIRR) of 28.0 percent. Given the uncertainties associated with various market and project-specific parameters, sensitivity study is carried out to assess the robustness of the economic viability of the Project investment. The analysis of the economic viability of the Project investment is highly robust to withstand large variations in key market and project-specific parameters, including (i) construction cost overruns of 20 percent; (ii) commercial operation day (COD) delay for two years; (iii) 20 percent cost overruns plus two years' delay in COD; (iv) 20 percent lower direct benefit from gas sales; (v) 20 percent lower local externalities; (vi) global externalities measured at the lower bound of the shadow price of carbon; and (vii) a combination of the above-mentioned adverse conditions. The outcomes of the sensitivity analyses confirm the robustness of the economic viability of the Project investment (Annex 3).

33. **Financial Analysis.** A cost benefit analysis is carried out from the perspective of Beijing Gas, over 27 years inclusive of a 6-year construction period. The costs associated with the Project include investment costs, costs of gas sold, operation and maintenance costs, taxes and duties, and financing charges. The benefits of the proposed Project are derived from revenues generated from increased gas sales in the Project area.

34. *Revenue and Costs.* Beijing Gas' gross margin on the LNG operation, i.e., domestic revenue minus the cost of import, is projected to grow continuously in the initial dozen years of 2022-34 and stay at 2034 level thereafter. Besides costs of gas purchase, other costs include: (i) staff salaries; (ii) repair costs; (iii) other expenses, such as administrative overhead, marketing, insurance, etc.; and (iv) business taxes and surcharges, such as urban construction and maintenance fee, education surcharges, etc.

35. *Outcomes of the financial analysis.* Based on the above-mentioned assumptions, the Project's investment yields a financial internal rate of return (FIRR) of 9.0 percent, exceeding the Project's weighted average cost of capital of 4.3 percent. Thus, the proposed Project is financially viable. Given the uncertainties associated with various market and project-specific parameters, sensitivity study is carried out to

assess the robustness of the financial viability of the Project investment. The analysis shows that the financial viability of the Project investment is robust to withstand large variations in key market and project-specific parameters, including (i) construction cost overruns; (ii) COD delays. The outcomes of the analysis confirm the robustness of the financial viability of the Project investment (Annex 3).

C. Fiduciary and Governance

36. **Procurement.** A procurement assessment has been conducted. Beijing Gas is familiar with the FIDIC's condition of contract and has experience in EPC contract management. Technical staff has been assigned to be responsible for procurement of EPC contractors. The assessments of the strategic elements and operational factors that may affect achievement of the procurement objectives, identification of fiduciary weaknesses and the proposal for mitigation measures to address these deficiencies is set out in the Project delivery strategy, which has been reviewed and accepted by the Bank. In addition, the internal governance measures and reporting lines in the Beijing Gas are identified in its management manual. Given the size of the proposed Project, the procurement risk is substantial. To mitigate the procurement risk, Beijing Gas has been suggested to engage an experienced procurement agent, who should be well conversant with the procurement policies, methods, procedures and standard tendering documents of international financing institutions.

37. **FM.** The Bank reviewed Beijing Gas' FM system for the proposed Project, with due attention to staffing, budgeting, accounting, financial reporting, funds flow, internal control procedures, and external auditing arrangements. Overall, the proposed Project's FM system is acceptable to the Bank to ensure project funds properly used with due efficiency and effectiveness. During appraisal, it was noted that (i) dedicated FM officials had been assigned for the proposed Project; (ii) Beijing Gas has a series of internal control and FM rules in place; and (iii) proper approval procedures and segregation of duties will be followed for all Project payment.

38. Major FM risks identified include: (i) Project's FM staff only has sector experience and knowledge and have no experience in managing projects financed by multilateral development banks; and (ii) the currently used Oracle accounting system could not generate summary data indicating individual contract implementation status. To mitigate such risks, the Bank has provided guidance to Beijing Gas on the specific FM requirements and disbursement procedures for the Project. Further training will be held after the start of the Project implementation. Also, the Bank's loan proceeds will be managed by the Beijing Municipal Finance Bureau, which has extensive experience on multilateral development bank financing and whose oversight will reduce fiduciary risk. Furthermore, the FM team of Beijing Gas is expected to coordinate with a software developer to optimize the ERP system, and further enhance the contract management function. Last, to properly monitor and report project funds, the Bank has clarified the reporting requirements and format, and Project financial statements will be prepared in accordance with MOF's requirement. The overall Project FM risk is categorized as Medium.

39. **Governance and Anti-corruption.** AIIB's Policy on Prohibited Practices (2016) has been explained to Beijing Gas and is covered in the legal agreements for

this financing. Implementation will be monitored regularly by AIIB. AIIB reserves the right to investigate—directly or indirectly through its agents—any alleged corrupt, fraudulent, collusive or coercive practices related to the proposed Project and to take necessary measures to prevent and redress any issues in a timely manner, as appropriate.

D. Environmental and Social

40. **Environment and Social Policy and Categorization.** AIIB's Environmental and Social Policy (ESP), including the Environmental and Social Standards (ESS) and Environmental and Social Exclusion List, are applicable to the proposed Project. The proposed Project has been assigned Category A, due to the nature of the Project activities, local environmental and social contexts, as well as environmental and social impacts of the associated facilities. ESS1, Environmental and Social Assessment and Management, and ESS2, Involuntary Resettlement, are applicable to the Project.

41. **Environmental and Social Instruments.** An Environmental and Social Impact Assessment (ESIA) has been prepared by the IE as required for the proposed Project activities, including an Environmental and Social Management Plan (ESMP), which describes the institutional arrangements, division of responsibilities, proposed mitigation measures, monitoring parameters and arrangements, and reporting requirements. Preparation of the ESIA/ESMP involved review, consolidation and supplementation of relevant reports/documents that were prepared for the proposed Project according to the national laws and regulations, e.g., environmental impact assessment (EIA) for maritime environment, EIA for construction and installation of LNG unloading wharf and LNG storage tanks, EIA for environmental sensitive areas (wetland and nature reserves).

42. **Environmental and Social Aspects.** The proposed Project is expected to bring positive environmental benefits by reducing coal combustion-related emissions such as CO₂, SO₂, NO_x and PM in the BTH region, where air quality used to be the worst in the country mainly due to concentrated energy-intensive heavy industries and massive coal consumption. The use of LNG to optimize the energy structure is of great significance to improve air quality and people's living conditions in the region. The design capacity of the LNG receiving terminal is about 5 million tons/year, equivalent to 6.94 billion m³ of natural gas per year. When in full operation, the proposed Project can reduce consumption of ordinary coal of approximately 11.9 million tons per year, thereby reducing CO₂ by 7.5 million tons per year, PM by 67,000 tons per year, SO₂ by 27,200 tons per year and NO_x by 78,400 tons per year.

43. The ESIA covers both the benefits of the proposed Project as well as environmental risks and impacts with regards to water, air, soil quality, biodiversity (both flora and fauna) and solid waste management. The document presents baseline data, screens potential environmental impacts, analyses the design and site selection for proposed activities, conducts an analysis of alternatives, and outlines mitigation measures to prevent or reduce direct and indirect impacts. These measures will be implemented by the IE, Project contractors and consultants and other concerned stakeholders during the Project's preparation, construction and operation phases.

44. Environmental impacts during construction are expected to be temporary, such as dust and noise from civil works, localized erosion, drainage and wastewater discharge during construction, hazardous materials and solid waste management. Other potential issues might also exist, including issues related to labor management, such as working environment, health and safety matters. Construction-related impacts of this nature will be short-term and manageable through adequate mitigation and monitoring. Environmental impacts during operation were assessed and found to be manageable as well, as there would be very little discharge from the Project facilities to the surrounding environment. The key issue in operation would be the hazardous materials management and workers' safety and health. Beijing Gas will provide appropriate training and make a safe operation manual available to its staff before operation starts, based on its practice and experience of managing other similar gas facilities.

45. Since the proposed Project will be constructed on land reclaimed from the Bohai Sea seven years ago, which is about 10 kilometers away from the original coastline and not close to any inhabitable area, minimal social risks and impacts are expected from development and operation of the LNG facilities and wharf. Following national law, initial approval for use of the site has been obtained for the Project.

46. **Alternative Analysis.** An alternative analysis was conducted for a without-project scenario. It concluded that the without-project scenario was not regarded as a desirable or appropriate alternative given the proposed Project's substantial socio-economic benefits at the local and regional levels, with respect to energy structure optimization, CO₂ reduction and air quality improvement. In addition, analyses were conducted to compare different project locations and processing technologies, in order to optimize the Project design and minimize possible environmental and social risks.

47. **Associated facility.** Construction of a gas transmission pipeline up to 229 km is regarded as an associated facility under the ESP. Upon completion, it will supply natural gas to the BTH region and will be interconnected with three major gas transmission pipelines in the region. In order to address the environmental and social impacts of this associated facility, separate safeguard documents, such as an Environmental Impact Assessment (EIA), including an environmental management plan (EMP), and a Social Impact Assessment, including a Resettlement Action Plan (RAP), have been prepared in accordance with AIIB's ESP. The documents review and identify mitigation measures applicable during the preparation, construction and operational phases to avoid, minimize and compensate any impacts identified; and Beijing Gas will be required to construct the pipeline in accordance with these environmental and social documents.

48. The construction of the associated gas pipeline, 7 stations and 3 valve houses will require permanent land acquisition of 10 hectares and temporary land occupations of 672 hectares. About 54 households and 203 persons will be affected by permanent land acquisition and 8,751 households and 27,157 persons will be affected by temporary land occupation. Based on a survey of project impacts and a series of consultations with local governments and communities, the RAP includes detailed

account of potential land acquisition impacts, identification of affected villages, description of resettlement policies and compensation standards according to national laws and local regulations, and institutional arrangement for implementation as well as grievance procedures. The RAP survey indicated that there are no vulnerable communities, people below poverty line, non-title holders or minority communities impacted by the associated facility.

49. **Health and Safety Aspects.** The environmental and social documentation for the Project addresses health and safety requirements and standards, labor management and management of worker and community relations, in line with the World Bank Group's Environmental, Health and Safety Guidelines.

50. **Monitoring and reporting.** Beijing Gas will engage a consultant to carry out the environmental and social monitoring during project implementation. The proposed parameters, locations, frequency and reporting requirements, have been specified in the environmental and social documents. Training on environmental and social monitoring and reporting will be carried out during implementation.

51. **Public consultation and information disclosure.** As required under the ESP and national policies, a series of stakeholder and public consultations³⁸ have been conducted and environmental and social information has been disclosed in the course of Project preparation. Consultations are planned to continue before and during construction. The draft ESIA/ESMP report for the LNG terminal and the draft EIA report and the RAP for the associated facilities, in Chinese and English, have been disclosed at Beijing Gas' website (<http://www.bjgas.com/news.aspx?id=7075>). These documents have also been disclosed on AIIB's site (<https://www.aiib.org/en/projects/proposed/2019/beijing-tianjin-hebei.html>).

52. **Grievance Redress Mechanism (GRM).** A project-level GRM in accordance with the requirements of AIIB's ESP has been established for the proposed Project and will start operating soon after the loan agreement becomes effective. A GRM covering construction workers will also be established.

53. **Project-affected People's Mechanism.** AIIB's Project-affected People's Mechanism (PPM) will govern this Project. It has been established by AIIB to provide an opportunity for an independent and impartial review of submissions from Project-affected people who believe they have been or are likely to be adversely affected by AIIB's failure to implement the applicable environmental and social policy in situations when their concerns cannot be addressed satisfactorily through the Project-level

³⁸ The Social Assessment Agency and the School of Public Policy and Management, Tsinghua University conducted a series of public consultations between October 2018 and July 2019. In August 2019, task force of the Shanxi Academy of Social Sciences conducted extensive consultation with the local natural resources and planning, and labor and social security bureaus, township governments, and village committees on compensation measures and rates, resettlement measures, attitudes, opinions, suggestions, etc.

GRMs or the processes of the Bank’s Management. For information on how to make submissions to the PPM, please visit the PPM web page.³⁹

E. Risks and Mitigation Measures

54. The proposed Project’s Risk Rating is “High”, given the size of Bank financing involved and the Project’s environmental and social category. Risk assessment and mitigating measures are presented in Table 4.

Table 4: Risk Assessment and Mitigation Measures

Risk Description	Assessment	Mitigation Measures
Delay in procurement and implementation	High	A PMO has been set up to lead the Project preparation and implementation, headed by senior officials and staffed by adequate personnel. Also, a procurement agent is engaged to help manage the procurement activities. Moreover, large EPC contracts will be used to attract international and domestic specialized contractors and minimize the construction risk.
Cost overrun	Medium	Costs of major equipment and materials benchmarked to similar ongoing projects in China, and provision of sufficient amount for contingencies. Beijing Gas has confirmed that any financing shortfalls will be covered by itself.
Foreign exchange rate risk	Medium	Beijing Gas is familiar with foreign currency-denominated transactions such as overseas acquisitions and purchase of LNG and has approaches for hedging the risk of foreign exchange rate.
Misuse of loan proceeds	Medium	There are acceptable systems and procedures in place to ensure proper usage of loan proceeds.
Environmental and Social related risks	High	Environmental and social related risks are mainly with the associated facility. Safeguard instruments, such as EIA, including an EMP, and SIA, including a RAP, have been prepared and will be implemented and monitored during construction. The PMO has assigned one environmental and one social staff responsible for the implementation of EMP and RAP. In the project preparation, stakeholder engagement, consultation with project affected persons and information disclosure have been carried out and similar activities will be conducted during construction. A GRM will be in place soon after the loan becomes effective.
Overall Rating	High	

³⁹ <https://www.aiib.org/en/policies-strategies/operational-policies/policy-on-the-project-affected-mechanism.html>.

Annex 1: Results Monitoring Framework

Project Objective:	The objective of the proposed Project is to increase the availability of natural gas to help reduce coal consumption and related emissions in the BTH region. The proposed Project is in line with China's endeavor to transit to a lower carbon energy supply structure.									
Indicator Name	Unit of measure	Baseline 2019	Cumulative Target Values					End Target	Frequency	Responsibility
			2020	2021	2022	2023	2024			
Project Objective Indicators:										
Annual coal consumption avoided	Million tons	0	0	0	1.79	3.57	4.76	11.90	Annually	Beijing Gas
Annual CO ₂ avoided	Million tons	0	0	0	1.13	2.25	3.00	7.50	Annually	Beijing Gas
Annual PM avoided	tons	0	0	0	10,050	20,100	26,800	67,000	Annually	Beijing Gas
Annual SO ₂ avoided	tons	0	0	0	4,050	8,100	10,800	27,000	Annually	Beijing Gas
Annual NO _x avoided	tons	0	0	0	11,700	23,400	31,200	78,000	Annually	Beijing Gas
Intermediate Results Indicators:										
Increase in LNG unloading capacity	Million tons	0	0	0	2.0	4.0	5.0	5.0	Semi-annually	Beijing Gas
LNG storage tanks (200,000 m ³ each)	number	0	0	0	4	8	10	10	Semi-annually	Beijing Gas

Annex 2: Detailed Project Description

A. Background

1. With increasing public awareness of environmental protection and frequently declared air pollution emergencies, it has become a common understanding that China needs to change its energy supply mix, reducing coal consumption, and transit to a more sustainable low-carbon development path, as coal combustion is the single-largest source for both air pollution and CO₂ emissions in China. The proposed Project is to increase the availability of natural gas to help replace and reduce coal consumption in the BTH region and will bring substantial benefits of carbon emissions reduction upon completion. It is in line with international community's efforts to combat the negative impact of climate change, and in accordance with the Government of China's policy priorities to reduce CO₂ emissions and improve regional air quality. Given its foreseeable environmental benefits, the proposed Project has been strongly supported by the Government.

B. Need for Coal to Gas Transition in the BTH Region

2. The BTH region is one of the most important economic engines in China and has been facing the dual challenges of increasing energy supply and addressing air pollution. In 2017 the BTH region, with a total population of about 112.5 million, consumed around 450 million tons of standard coal equivalent, of which around 50 percent was covered by coal.⁴⁰ The BTH region, particularly Hebei and Tianjin, has many energy-intensive heavy industries, and consistently experiences poor air quality mainly due to an excessive reliance on coal and insufficient environmental protection measures. After years' endeavor to improve air quality, the share of coal to total energy consumption in Beijing was already reduced to about 5.0 percent in 2017. However, in 2017 the shares of coal in Tianjin and Hebei were still around 34.6 percent and 64.4 percent, respectively. This probably explains why the absolute level of air pollution remains high in the BTH region. For example, the BTH region's annual average PM_{2.5} concentration was about 53 microgram per cubic meter (µg/m³) in 2018, representing an approximately 17 percent progress compared to 2017, but still far below the World Health Organization's standard (i.e. annual mean not exceeding 10 µg/m³).⁴¹

3. During the 12th Five Year Plan period (2011-2015), local governments in the BTH region pushed out many policies and measures for air pollution control. For example, during the period of 2011-2015 Beijing Municipality closed several large coal-fired power plants, converted more than 200,000 tons/hour coal-fired boilers into gas-fired boilers, and provided about 200,000 natural gas connections to urban and rural households. In 2017, the Government of China issued the BTH Region Coordinated Development Plan on Energy (2017-2020), which required local governments in the BTH region to promote green development, reduce coal consumption, and speed up the low-carbon energy transition, with

⁴⁰ China Energy Statistics Yearbook, 2018.

⁴¹ World Health Organization, 2019. Ambient (outdoor) air quality and health. Access at: [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)

specified coal reduction target. For instance, by 2020, in Beijing Municipality coal should be eliminated in the plain areas; in Tianjin Municipality coal for heating should be eliminated in the plain areas, and anthracite might still be used for heating in mountainous areas based on local condition; in Hebei Province coal for heating should basically be eliminated in the plain areas. These targets will not be possible without sufficient natural gas supply in the region.

4. Driven by the coal-to-gas conversion and increased demand for heating during the unexpected harsh winter in 2017, the seasonal gas demand achieved a record high. This created a serious gas supply shortage in north China. It was estimated that during December 2017 the daily supply shortage in China was around 69 million cubic meters, of which around 30 million cubic meters were in the BTH region. Many households in north China, particularly in rural areas, were forced to go back to coal-fired stoves for heating. Taking this lesson learned, the National Development and Reform Commission and National Energy Administration in 2018 issued a joint administrative decree requiring local governments and gas companies to build their own gas supply emergency reserve capacity to maintain people's livelihood in case of need, which states: (i) local governments should have a reserve capacity covering at least 3-days gas supply in their administrative areas; (ii) gas supply companies should have a reserve capacity no less than 10 percent of their annual supply volume; and (iii) city gas utilities should have a capacity no less than 5 percent of their annual supply volume. Besides increasing gas supply in the BTH region by financing LNG unloading and regasification facilities, the proposed Project also includes the construction of 10 LNG storage tanks with a volume of no less than 200,000 cubic meters each, which can be a useful buffer in time of need for the BTH region.

C. Project Activities

5. The proposed Project is to construct a LNG terminal in Binhai District, Tianjin Municipality, which includes two components. AIIB financing is planned to be used in the construction of LNG receiving, storage and regasification facilities under Component One.

- **Component One: construction of LNG receiving, storage and regasification facilities.** Proposed activities under Component One include the construction of LNG receiving facility with an annual handling capacity of 5 million tons of LNG, 10 LNG storage tanks with a volume of no less than 200,000 cubic meters each, and regasification facility with a maximum daily operating capacity of 60 million cubic meters of natural gas.
- **Component Two: construction of unloading wharf.** Proposed activities under Component Two include the construction of a working platform, 4 mooring dolphins and 6 mooring cleats.

6. The Project's activities, such as LNG receiving facility, storage tanks and regasification facility, will be constructed on a piece of land claimed from the Bohai Sea seven years ago, which is far away from the original coastline and any inhabitable area and currently owned by the local government. Figure A2.1 is the effect drawing of the proposed Project after completion.

Figure A2.1: Proposed Project After Completion (Effect Drawing)



D. Project Implementation Entity

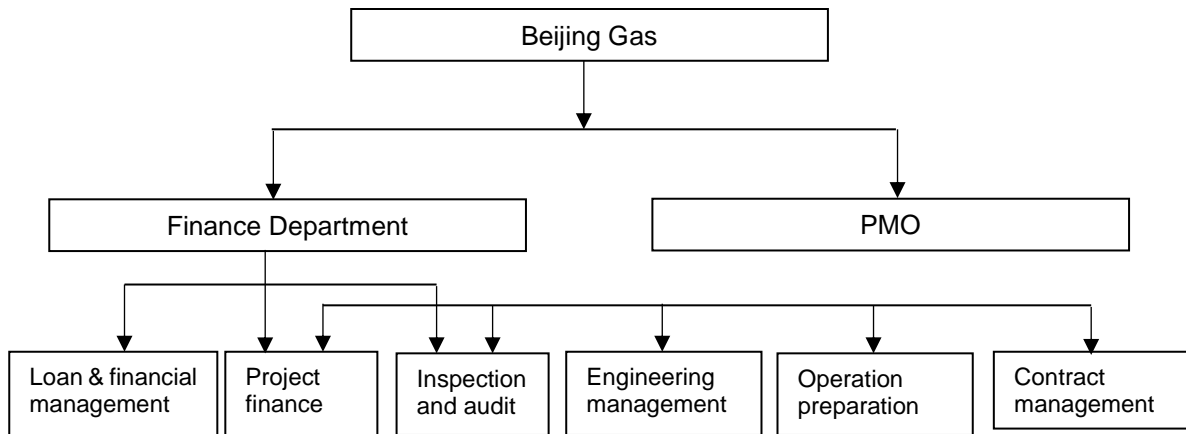
7. The Project will be implemented by Beijing Municipality and Beijing Gas Group Company Limited (Beijing Gas). Beijing Gas was established in 1958 and is currently the largest gas supplier for a single city in Asia and the second largest worldwide, leading the sector in terms of the scale of its pipeline network, number of consumers, and annual gas sales. Its pipeline network covers all six central districts and most suburban districts of Beijing. Beijing Gas is primarily engaged in the sale of piped gas through terminals in Beijing to households and industrial consumers, but it has also developed downstream businesses, such as distributed energy, district heating, and gas vehicle refilling. It also owns assets in pipeline-based gas transmission, LNG receiving stations and LNG processing. Beijing Gas is well-known in the international natural gas sector. In 2017 its chairperson was elected President of the International Gas Union for 2021-2024, and Beijing will host the 2024 World Gas Conference. Beijing Gas is expected to take a leading role in bringing together companies, policy makers, and other external stakeholders to promote gas as an essential and sustainable part of the future energy mix.⁴²

8. Beijing Gas has a well-developed corporate structure with clearly defined roles and responsibilities for all project-related tasks. This structure has proven to be effective, as evidenced by its successful track record in implementing large gas transmission and distribution projects in the past. The implementation arrangements for the proposed Project will make best use of Beijing Gas's existing project management and monitoring systems. Beijing Gas will have full responsibility for Project implementation. Beijing Gas' Finance Department and Project Management Office will be the key interfaces between Beijing Gas

⁴² International Gas Union (IGU). The People's Republic of China Wins Bid for International Gas Union Presidency. News and Resources, Oct. 26, 2017. <https://www.igu.org/news/people%E2%80%99s-republic-china-wins-bid-international-gas-union-presidency>.

and AIIB. Beijing Gas has assigned one environmental officer and one social officer responsible for monitoring environmental and social related matters. AIIB will discuss and agree with Beijing Gas on the Project's monitoring and supervision plans before the implementation of the Project starts.

Figure A2.2: Project Management Structure



Annex 3: Economic and Financial Analyses

A. Economic analysis

a. Background

1. The Beijing-Tianjin-Hebei (BTH) region, home to 112.5 million people, is one of the most environmentally challenged regions in China and has been facing the dual challenges of fueling economic growth and addressing air pollution. In 2017 the BTH region consumed around 450 million tons of standard coal equivalent, of which around 50 percent was covered by coal.⁴³ Due to an excessive reliance on coal and insufficient environmental protection measures, the BTH region consistently experiences poor air quality. For example, the BTH region’s annual average concentration of PM_{2.5} in 2018 was about 53 microgram per cubic meter (µg/m³), representing an approximately 17 percent progress compared to 2017, but still far below the World Health Organization’s standard (i.e. annual mean not exceeding 10 µg/m³).⁴⁴

2. Natural gas has been a key ally in China’s war on air pollution. Since 2013, air quality improvement has been high on the policy agenda. Correspondingly, the Government of China progressively adopted many stringent restrictions on coal use tied to measurable targets for air quality improvement. Early efforts focused on closing small coal-fired boilers and providing gas connections in urban areas. More recent endeavors started to set specific goals to use natural gas, as well as electricity, geothermal, and combined-heat-and-power (CHP) technologies to replace coal for heat, aiming to combat peaks in air pollution during the winter heating season. Compared to other technologies, natural gas has a competitive advantage in terms of heating costs and emissions (Figure A3.1).⁴⁵ This is especially true for households in the north with greater heating needs in the winter. Also, since majority of electricity is currently generated by coal-fired power plants in China, environmental benefits in using electricity-based options would be limited.

Figure A3.1: Heating Costs and Emissions Intensity of Different Technologies



Source: IEA, 2019.

⁴³ China Energy Statistics Yearbook, 2018.

⁴⁴ World Health Organization, 2019. Ambient (outdoor) air quality and health. Access at: [https://www.who.int/news-room/fact-sheets/detail/ambient-\(outdoor\)-air-quality-and-health](https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health)

⁴⁵ IEA, 2019. The Role of Gas in Today’s Energy Transitions. Paris, France.

4. There is a greater urgency in implementing rural coal-to-gas project. Most of the coal-to-gas switching to date has occurred in urban areas, since the costs and the financial returns for connecting rural customers are more challenging. However, rural loose coal normally contains higher quantities of sulphur, nitrogen and ash than that of the more refined coal available to large scale industrial users, which also have air quality control systems. A very recent IEA study in China showed that, although this part of lower quality coal accounts for only 10 percent of total coal consumption in “2+26” cities (Beijing, Tianjin and additional 26 cities in the surrounding provinces of Hebei, Henan, Shanxi and Shandong), it is responsible for half of air pollutant emissions.⁴⁶

5. There is an urgent need for emergency reserve of natural gas. Driven by the coal-to-gas conversion and increased demand for heating during the unexpected harsh winter of 2017/18, the seasonal gas demand reached a record high level, which were compounded by insufficient storage and LNG regasification capacity, shortfalls in piped imports and internal infrastructure bottlenecks. During December 2017 the daily supply shortage in China was estimated to be around 69 million cubic meters, of which around 30 million cubic meters were in the BTH region. Many households in the BTH region, particularly in rural areas, were forced to go back to coal-fired stoves for heating. Taking this lesson learned, the Government in 2018 formally required local governments and gas companies to build up their emergency reserve capacity of gas supply to maintain people’s livelihood when and as needed. Besides financing LNG unloading and regasification facilities, the proposed Project includes the construction of 10 LNG storage tanks with a volume of no less than 200,000 cubic meters each, which can be a useful buffer in time of need for the BTH region.

6. China’s efforts to improve air quality by choosing gas generate important benefits for CO₂ emission reduction. According to IEA, coal-to-gas switching reduces CO₂ emissions by around 40% for each unit of energy output.⁴⁷ In more carbon-intensive energy systems like China and India, it can play a significant role alongside the increase of renewable energy. By 2040, coal-to-gas switching in China will reduce nearly 1.0 giga tons of CO₂, generating 15% of the additional savings required in IEA’s Sustainable Development Scenario.⁴⁸

b. Methodology and key assumptions

7. A cost benefit analysis is carried over a project lifetime of 27 years inclusive of a 6-year construction period, at a social discount rate of 10 percent. All costs and benefits are estimated in constant 2019 prices with an average exchange rate of CNY 7.07 to USD1.0, excluding transfer payments, taxes and duties, financing charges, and adjusted for any market distortions.

8. **Costs.** The costs associated with the Project include (i) the investment costs of the LNG receiving and processing facilities to be constructed under the Project; (ii) the costs of

⁴⁶ IEA, 2019. The Role of Gas in Today’s Energy Transitions. Paris, France.

⁴⁷ International Energy Agency (IEA), 2019. The Role of Gas in Today’s Energy Transitions.

⁴⁸ IEA’s Sustainable Development Scenario provides a benchmark for measuring progress towards a more sustainable energy future, in contrast with the World Energy Outlook’s other scenarios that track current and planned policies. Specifically, it integrates the objectives of the three Sustainable Development Goals (SDGs) that are most closely related to energy.

LNG import; (iii) the costs of operating and maintenance of the receiving, storage and regasification facility constructed under the Project; (iv) the transportation costs of natural gas to Beijing, including a separate investment in a natural gas pipeline and the costs of operating and maintaining the pipeline. Port price for LNG is estimated at USD8.5 per million BTU or CNY 3,006 per ton, which is decided based on (i) long-term LNG supply contract price and (ii) projection of spot market price, excluding taxes and duties.

9. **Benefits.** The benefits of the Project include (i) direct benefit from gas sales; (ii) positive local externalities of avoided local air pollutants; and (iii) positive global externality of avoided CO₂ emissions.

10. **Direct benefit from gas sales.** The imported LNG will be processed into gas or filled into tanks in liquid forms to serve end-users in the BTH region. The primary use of the processed LNG is to meet the drastically grown demand from the heating sector that had recently undergone a fuel switch from coal to gas. On top of the cost of LNG import, Beijing Gas charges end-users a wheeling charge to cover its cost of service alongside a processing margin. LNG import handled by the Project is projected to grow gradually from 750,000 ton in 2022 to the full capacity of 5.0 million ton in 2034. Table A3.1 provides a projection of the imported LNG from the facility.

Table A3.1: Projection of LNG import handled by the Project

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034-
Gas (million m ³)	800	1600	2000	2200	2400	2500	2800	3000	3200	3500	3800	4200	4500
Liquid (million ton)	0.15	0.3	0.50	0.55	0.60	0.70	0.70	0.75	1.00	1.2	1.35	1.45	1.70
Total (million ton)	0.75	1.50	2.00	2.20	2.40	2.60	2.80	3.00	3.40	3.80	4.20	4.60	5.00

Source: Beijing Gas estimate.

11. **Replacement of coal.** On pure energy basis, 5.0 million tons of LNG will replace an approximately 11.9 million tons of ordinary coal, with a calorific value of 5,000 kcal/kg primarily for heat in the BTH region.

Table A3.2: With- and without- Project scenarios

	Without Project	With Project
Fuel Type	Ordinary coal	LNG
Heat content	5,000 kcal/kg	35.91 MJ/m ³
Fuel weight	11.9 million tons	5 million tons

Source: Beijing Gas and AIIB estimates.

12. **Local externalities.** Dependence on coal has caused many environmental and human health problems. Replacing coal with natural gas in the BTH region will result in substantial reduction in the emissions of local air pollutants, such as SO₂, NO_x and PM. Table A3.3 provides a summary of the estimates of the emission reductions due to the Project intervention.

Table A3.3: Avoided emissions as a result of the Project intervention

		Without Project	With Project	Avoided
	Type	Ordinary coal	LNG	
Fuel	Heat content	5,000 kcal/kg	35.91 MJ/m ³	
	[million ton]	11.90	5.0	
SO ₂	[ton]	27,225	-	27,225
PM	[ton]	67,000	-	67,000
NO _x	[ton]	90,927	12,486	78,441
Total local pollutants	[ton]	185,152	12,486	172,666

Source: Beijing Gas and AIIB estimates.

13. Damages of environmental pollution can be classified according to their impacts on human health, agriculture, forests, fisheries, materials (including buildings) and water resources. Air pollution or pollution of rivers and lakes may also detract from recreation and aesthetic experiences. Since not all damages (particularly those non-health-related ones) can be quantified and monetized, this analysis will focus on the impacts of air pollution on health, which have been identified to be severe in both absolute and economic value terms in existing studies.⁴⁹ Since the rural poor are at a substantially higher risk from surface water pollution caused by acid rain compared with urban dwellers and rural population above the poverty line, replacing coal with natural gas will provide additional benefits to the rural poor.

14. **Health impact of ambient air pollution.** In recent years, epidemiological studies conducted around the world have demonstrated that there are close associations between air pollution and health outcomes, including respiratory symptoms, reduced lung function, chronic bronchitis, and mortality. PM and SO₂ are chosen in many studies as the indicative pollutants for evaluating the health effects of ambient air pollution.⁵⁰ Although the mechanisms are not fully understood, epidemiological evidence suggests that outdoor air pollution is a contributing cause of morbidity and mortality. One city-level study in China shows the PM-related death alone was from 0.77 million to 1.258 million by using different exposure-response functions (Maji et al., 2018).⁵¹

15. **Monetized benefits of avoided air pollution.** Using different approaches, many studies have attempted to quantify the economic costs of air pollution in China. Based on a value of a statistical life (VSL) method as per people's willingness-to-pay (WTP) to avoid mortality risks, the World Bank (1997 and 2007) estimated the damages associated with air pollution at 4.6 percent and 3.8 percent of China's annual GDP in 1995 and 2003, respectively.⁵²

⁴⁹ World Bank, 2007. Cost of Pollution in China: Economic Estimates of Physical Damages.

⁵⁰ Idem.

⁵¹ Yang Xie, Hancheng Dai, Yanxu Zhang, Yazhen Wu, Tatsuya Hanaoka, Toshihiko Masui, Comparison of health and economic impacts of PM2.5 and ozone pollution in China, Environment International, Volume 130, 2019

⁵² Clear Water, Blue Skies: China's Environment in the New Century, World Bank (1997); and Cost of Pollution in China: Economic Estimates of Physical Damages, the World Bank (2007).

Table A3.4: Sample Studies to Quantify the Economic Costs of Air Pollution in China

Source	Damages associated with air pollution (1997 USD)	Percent of GDP (year)
Clear Water, Blue Skies: China's Environment in the New Century, World Bank (1997)	USD33.9 billion	4.6% (1995)
Cost of Pollution in China: Economic Estimates of Physical Damages, World Bank & State Environmental Protection Administration (2007)	USD54.6 billion	3.8% (2003)
Health damages from air pollution in China (Matus, et al., 2012) ⁵³	USD103.9 billion	5.9% (2005)

16. This analysis has adopted the WTP-based VSL methodology. Based on the methodology, the World Bank and the State Environment Protection Administration of China (2007) study estimated the damage cost per unit ton of SO₂ and PM in 2003 in China.⁵⁴ The damage cost estimates are adjusted to reflect per capita GDP growth from 2003, i.e., the base year of the estimates, to 2018; and from 2019 thereafter, a conservative income growth of 2 percent per annum is adopted. Moreover, a unit damage cost of NO_x is estimated based on the estimated environmental cost ratio between SO₂ and NO_x used in a World Bank Poland study (2018).⁵⁵

Table A3.5: Cost Estimate of Avoided Emissions under the Project

Avoided emissions (ton)	Local Externalities		
	Unit cost – China (CNY/ton in 2003)	Total avoided cost	
		2003 CNY million	2018 CNY million
SO ₂ 27,225	1,703	46	160
TSP 67,000	26,062	1,746	6,008
NO _x 78,441	4,604	361	1,242
Total		2,154	7,410

17. **Global externalities.** Coal-to-gas switching in China has not only helped improve air quality, but also helped reduce CO₂ emissions.⁵⁶ Replacing coal with natural gas in the BTH will result in substantial reduction in the emissions of CO₂. By 2040, coal-to-gas switching in China will reduce nearly 1.0 giga tons of CO₂, generating 15% of the additional savings required in IEA's Sustainable Development Scenario.⁵⁷ Table A3.6 provides an estimate of CO₂ emissions reduction due to the Project intervention.

⁵³ Matus, K., K.-M. Nam, N.E. Selin, L.N. Lamsal, J.M. Reilly and S. Paltsev (2012): Health damages from air pollution in China. *Global Environmental Change*, 22(1): 55-66 (<http://dx.doi.org/10.1016/j.gloenvcha.2011.08.006>)

⁵⁴ Ibid.

⁵⁵ World Bank, 2018. Poland Energy Transition: The Path to Sustainability in the Electricity and Heating Sector.

⁵⁶ IEA, 2019. Gas 2019 Executive Summary: Analysis and Forecast to 2024.

⁵⁷ IEA's Sustainable Development Scenario provides a benchmark for measuring progress towards a more sustainable energy future, in contrast with the World Energy Outlook's other scenarios that track current and planned policies. Specifically, it integrates the objectives of the three Sustainable Development Goals (SDGs) that are most closely related to energy.

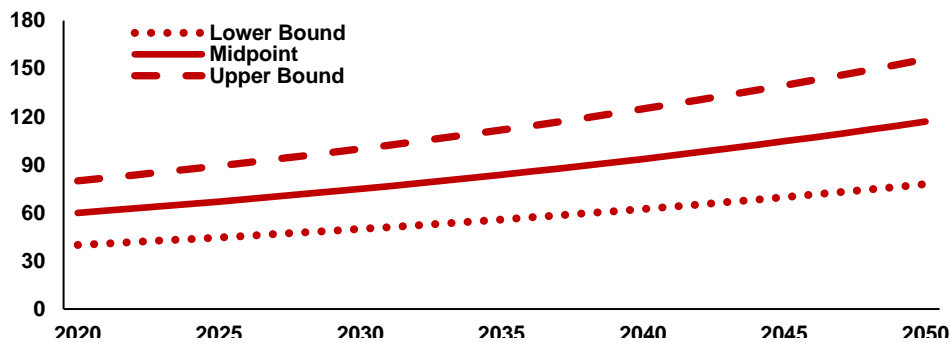
Table A3.6: Avoided emissions as a result of the Project intervention

		Without Project	With Project	Avoided
	Type	Ordinary coal	LNG	
Fuel	Heat content	5,000 kcal/kg	35.91 MJ/m ³	
	[million ton]	11.90	5.0	
CO ₂	[million tCO ₂]	21.34	13.83	7.50

Source: Beijing Gas and AIIB estimates.

18. Shadow price of carbon is assumed to be the average of the lower and upper estimates recommended by the World Bank’s Guidance Note on Shadow Price of Carbon in economic analysis (Figure A3.2) ⁵⁸.

Figure A3.2: Recommended shadow price of carbon
(in USD per ton of CO₂ equivalent, constant prices)



Source: [Guidance note on shadow price of carbon in economic analysis](#), The World Bank, Nov 12, 2017.

19. **Outcome of the economic analysis.** With a project lifetime of 27 years, inclusive of a 6-year construction period and a 21-year operational life, the Project investment yields an estimated economic internal rate of return (EIRR) of 28.0 percent.

Table A3.7: Calculation of EIRR

Economic analysis											
		2019	2020	2021	2022	2023	2024	2025	2026	...	2045
Costs											
Investments											
Project direct investments	[RMB million]	1,507	3,012	3,073	1,973	-	-	-	-	-	-
Natural gas pipeline	[RMB million]	-	1,876	1,276	819	338	84	-	-	-	-
LNG import	[RMB million]	-	-	-	2,255	4,509	6,012	6,614	7,215	15,031	15,031
O&M											
LNG receiving, storage and regasification	[RMB million]	-	-	-	364	459	514	532	543	635	635
Natural gas pipeline	[RMB million]	-	-	-	119	129	132	132	132	132	132
Benefits											
Direct benefit from gas sales	[RMB million]	-	-	-	2,645	5,290	7,053	7,758	8,463	17,668	17,987
Local externalities	[RMB million]	-	-	-	1,203	2,454	3,338	3,745	4,167	12,400	12,648
Global externalities	[RMB million]	-	-	-	71	145	197	221	247	769	788
Net benefits	[RMB million]	(1,507)	(4,889)	(4,348)	(1,611)	1,640	3,643	4,446	4,987	15,039	15,624
EIRR		28.0%									

⁵⁸ [Guidance note on shadow price of carbon in economic analysis](#), The World Bank, Nov 12, 2017.

20. **Sensitivities.** Given the uncertainties associated with various market and project-specific parameters, sensitivity study is carried out to assess the robustness of the economic viability of the Project investment. The analysis of the economic viability of the Project investment is highly robust to withstand large variations in key market and project-specific parameters, including: (i) construction cost overruns of 20 percent; (ii) commercial operation day (COD) delay for two years; (iii) 20 percent cost overruns plus two years' delay in COD; (iv) 20 percent lower direct benefit from gas sales; (v) 20 percent lower local externalities; (vi) global externalities measured at the lower bound of the shadow price of carbon; and (vii) a combination of the above-mentioned adverse conditions. The outcomes of the sensitivity analyses confirm the robustness of the economic viability of the Project investment. The outcomes of the analysis are summarized below.

Table A3.8: Sensitivity analysis – EIRR

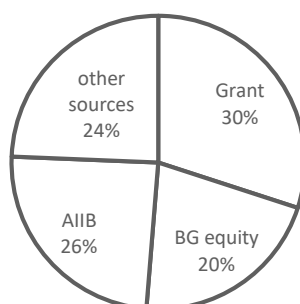
No.	Scenario	EIRR (%)
0	Base case	28.0%
1	[1] Investment cost (+20%)	24.6%
2	[2] COD 2-year delay	22.8%
3	[1] + [2]	20.3%
4	[4] Direct benefit from gas sales (-20%)	22.0%
5	[5] Local externality (-20%)	24.1%
6	[6] Global externality (lower bound carbon value)	27.0%
7	[3] + [4] + [5] + [6]	14.5%

B. Financial Analysis

21. **Methodology and key assumptions.** A cost benefit analysis is carried out from the perspective of Beijing Gas, the project implementing agency, over 27 years inclusive of a 6-year construction and expansion period. All costs and benefits to Beijing Gas are expressed in local currency and in nominal terms. The costs associated with the Project include investment costs, costs of gas sold, operation and maintenance (O&M) costs, taxes and duties, and financing charges. The benefits of the Project are derived from revenues generated from increased gas sales in the project area.

22. **Investment and financing.** The total investment is estimated around USD1,905 million (CNY13,476 million), 30 percent of which will be financed by a grant from the municipal government. With mounting environmental pressure especial due to air pollution, Beijing Municipal Government is stepping up its financial support to steer the city's energy mix away from coal. AIIB will provide USD500 million, about 26 percent of the investment, in debt financing, with the remaining will be financed by Beijing Gas' equity investment and borrowing from other financiers. Figure A3.4 provides an illustration of the Project financing mix.

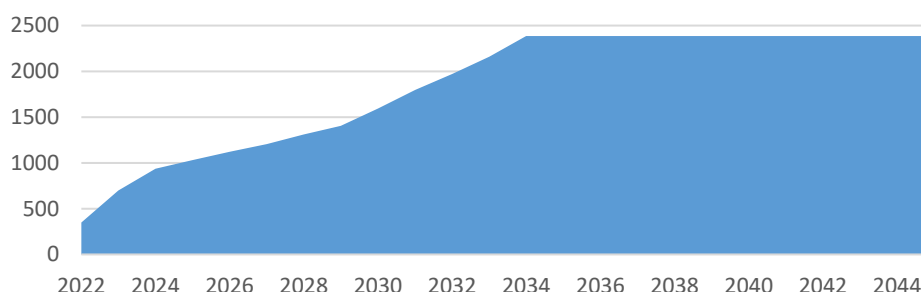
Figure A3.4: Project financing mix



23. **Weighted average cost of capital (WACC).** Linked to the London interbank offered rate (LIBOR), the interest rate for AIB’s US dollar denominated loan is assumed around 3.0 percent. The interest rate for the remaining commercial loan is assumed at 4.9 percent per annum. According to the government’s public sector investment guideline, the required return on equity (ROE) for the gas services sector is at 8.0 percent. Thus, with the corporate tax rate at 25 percent, WACC of the Project is estimated at around 4.3 percent.

24. **Revenue and cost of goods sold.** Beijing Gas’ gross margin on the LNG operation, i.e., domestic revenue minus the cost of import, is projected to grow continuously in the initial dozen years of 2022-34 and stay at 2034 level thereafter.

Figure A3.5: Revenue (gross margin) projection (2022-2045)



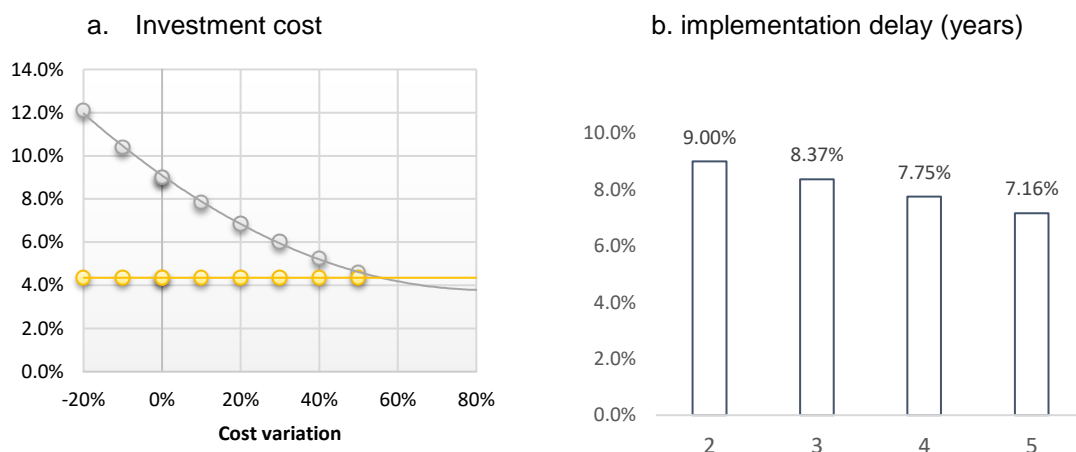
25. **O&M costs.** Besides costs of gas purchase, the O&M costs include: (i) staff salaries; (ii) repair costs; (iii) other expenses, such as administrative overhead, marketing, insurance, etc.; and (iv) business taxes and surcharges, such as urban construction and maintenance fee, education surcharges, etc. Detailed assumptions in each of the above-mentioned areas is documented in the project files.

26. **Outcomes of the financial analysis.** Based on the above-mentioned assumptions, the Project’s investment yields a financial internal rate of return (FIRR) of 9.0 percent, exceeding the Project’s WACC of 4.3%. Thus, the Project is financially viable.

Financial analysis		2019	2020	2021	2022	2023	2024	2025	2026	...	2045
Cash inflow (operating & investment)											
Municipal government CAPEX subsidy	[RMB million]	-	1,641	1,116	717	296	73	-	-	-	-
Operating income	[RMB million]	-	-	-	390	781	1,040	1,144	1,248	2,637	2,956
Total cash in	[RMB million]	-	1,641	1,116	1,107	1,076	1,114	1,144	1,248	2,637	2,956
Cash inflow (operating & investment)											
Investment	[RMB million]	1,824	3,647	3,720	2,389	985	245	-	-	-	-
Operating expenses	[RMB million]	-	-	-	364	459	514	532	543	635	635
Total cash out	[RMB million]	1,824	3,647	3,720	2,753	1,445	759	532	543	635	635
Net cash before tax	[RMB million]	(1,824)	(2,006)	(2,604)	(1,646)	(369)	355	612	705	2,002	2,320
Tax	[RMB million]	-	-	-	-	-	-	-	12	434	434
Net cash after tax	[RMB million]	(1,824)	(2,006)	(2,604)	(1,646)	(369)	355	612	692	1,568	1,887
FIRR		9.0%									
WACC		4.3%									

27. Sensitivities. Given the uncertainties associated with various market and project-specific parameters, sensitivity study is carried out to assess the robustness of the economic viability of the Project investment. The analysis the financial viability of the project investment is highly robust to withstand large variations in key market and project-specific parameters, including (i) construction cost overruns; (ii) COD delays. The outcomes of the analysis confirm the robustness of the financial viability of the Project investment. The outcomes of the analysis are summarized below.

Figure A3.6: Sensitivities of FIRR



Annex 4: Sovereign Credit Fact Sheet

A. Recent Economic Development

1. Based on 2018 data, China had a population of 1.393 billion and was an upper-middle-income country with GNI per capita in current USD as \$9,470 (Atlas method)⁵⁹. China's economic growth has been trending down, from 6.8 percent in 2017 to 6.6 percent in 2018. Albeit the downward trend, the economy remains resilient, and the structural reform has borne fruits. On the demand side, internal rebalancing toward consumption has accelerated, with the contribution exceeding 70 percent of GDP growth. On the supply side, the rebalancing toward services has stalled, with the contribution from services stabilizing at around 60 percent of GDP growth, which is over 20 percentage points more than the manufacturing sector.

2. Inflation dropped from 1.1 percent to -0.1 percent from 2015 to 2016 and remained subdued around 2 percent between 2017 and 2018. Starting in July 2018, there has been a series of policy rate cut leading to increase financial liquidity.⁶⁰ The gross public debt increased from 23.7 percent to GDP in 2017 to 37.9 percent in 2018, while the revenue moderated as land sale revenues contracted at the end of 2018.⁶¹ The combined effect led to a decline in the government overall balance from -3.1 percent of GDP in 2015 to 0.1 percent in 2018.

3. Regarding the external sector, the current account surplus decreased from 2.7 percent in 2015 to 0.4 percent in 2018. This mainly reflects a shrinking trade balance (driven by high import volume growth) and a continued increase in the services deficit (mostly driven by tourism), as well as higher commodity and semiconductor prices. The exchange rate of CNY against USD reached 6.88 at the end of 2018, depreciating 6 percent from 2015. As a combined effect, the gross official reserve shrank from USD 3.4 trillion in 2015 to USD 3.1 trillion in 2018, which is still adequate because the FX reserve coverage exceeds 15 months – way above the 3-month threshold.

B. Economic Indicators

Selected Macroeconomic indicators (2015-2021)

Economic Indicators	2015	2016	2017	2018	2019*	2020*	2021*
Real GDP growth (in percent)	6.9	6.7	6.8	6.6	6.2	6.0	6.0
Inflation (GDP deflator, in percent)	1.1	-0.1	2.4	2.1	1.5	1.8	2.1
Current account balance (percent of GDP)	2.7	1.8	1.6	0.4	0.5	0.4	0.2

⁵⁹ The income is within the range of a GNI per capita \$3,896 - \$12,055, making China an upper-middle income country according to World Bank 2019 fiscal year criteria.

⁶⁰ The 7-day reverse repo rate for deposit institutions fell by about 25 basis point following the rate cut in July, 2018, and has remained low while other policy rate reduced further. Source: Reuters <https://www.reuters.com/article/us-china-cenbank-banks/china-boosts-liquidity-set-for-more-policy-easing-as-trade-war-threatens-economy-idUSKBN1K91KB> [Last accessed on Sept 19, 2019]. The easing policy later boosted bond financing, particularly for short-to-medium-term notes issuers Source: China Economic Review. <https://chinaeconomicreview.com/peoples-bank-to-boost-bond-market-liquidity-with-new-loans/> [Last accessed on Sept. 19, 2019]

⁶¹ IMF staff estimation. Source: IMF Country Report No. 19/266.

Economic Indicators	2015	2016	2017	2018	2019*	2020*	2021*
Central government overall balance (percent of GDP)	-3.1	-4.0	0.8	0.1	0.0	0.0	0.0
Nominal gross public debt (percent of GDP)	23.7	23.7	36.8	37.9	40.2	43.1	45.4
Public gross financing needs (percent of GDP)	11.7	11.7	11.0	10.2	9.6	9.8	11.1
Non-financial corporate domestic debt (percent of GDP)	121	136	130	124	124	124	124
External debt (percent of GDP, end period)	12.3	12.6	14.6	14.8	14.9	14.7	14.4
Gross official reserves (USD billions)	3,406	3,098	3,236	3,168	3,167	3,174	3,177
FX reserve coverage (months of imports)	18.2	18.6	20.0	17.2	-	-	-
Broad money (M2, annual percentage change)	13.3	11.3	9.0	8.1	-	-	-
Exchange rate (CNY/USD, yearly) **	6.49	6.94	6.51	6.88	7.09	-	-

Note: * denotes projected figures.

** FX rate from Refinitiv, 2019 FX data as of Sept 23rd, 2019

*** Public Debt forecast is based on a narrow coverage scenario, including central government debt and "on-budget" local government debt identified by the authorities

Source: IMF Country Report No. 19/266.

C. Economic Outlook and Risks

4. Looking ahead, real GDP growth is projected to slow from 6.2 percent in 2019 to 6.0 percent in 2021. The economic outlook in China remains positive, given the still sizable gap between China's labor productivity and that of advanced economies which implies considerable room for further productivity convergence. If the policy continues to focus on the shift to high-quality growth, expanding market-oriented sectors, longer-term growth would be robust and more sustainable, notwithstanding near-term weaknesses.

5. There are several risk factors in China. On the external side, a further escalation in trade tensions could result in higher tariffs, disrupting supply chains and investment confidence, especially in the private sector. Export ban on certain Chinese technology companies could exacerbate this trend. On the domestic side, concerns about sharp downturn on the property market and a return to PPI deflation mount, as the asset quality of financial institutions deteriorate and funding stress for small-and-medium enterprise increases.

6. China has relatively low risks to debt sustainability, as the overall government fiscal position is projected to be roughly balanced. The external debt is projected to remain stable around 14 percent of GDP during the same time, and public debt (narrow coverage) will increase modestly by 5 percent between 2019 and 2021. However, on the augmented-debt-basis⁶², the debt dynamics are worsening – from 80 percent in 2019 to 91.1 percent in 2021, and the off-budget public investments pose large risks to debt sustainability. China's future debt profile will largely depend on the implementation of fiscal measures and on the willingness to reduce the off-budget activities and support macroeconomic rebalancing.

⁶² *Augmented Debt* is estimated in the broad coverage scenario by IMF staff. Source: IMF Country Report No. 19/266.

Annex 5: Project Implementation Arrangements

A. Implementation Readiness Activities

Table A5.1: Planned Timelines

Indicative Activities	Months						Responsible Entities
	2019.10	2019.11	2019.12	2020.01/02	2020.03/04	2020.05/06	
Advance contracting actions	X	X	X				Beijing Gas and AIIB
AIIB loan approval			X				Government, Beijing Gas and AIIB
Loan signing					X		Government, Beijing Gas and AIIB
Legal opinion provided						X	Government, Beijing Gas
Loan effectiveness						X	AIIB

Source: AIIB and Beijing Gas estimate.

B. Project Implementation

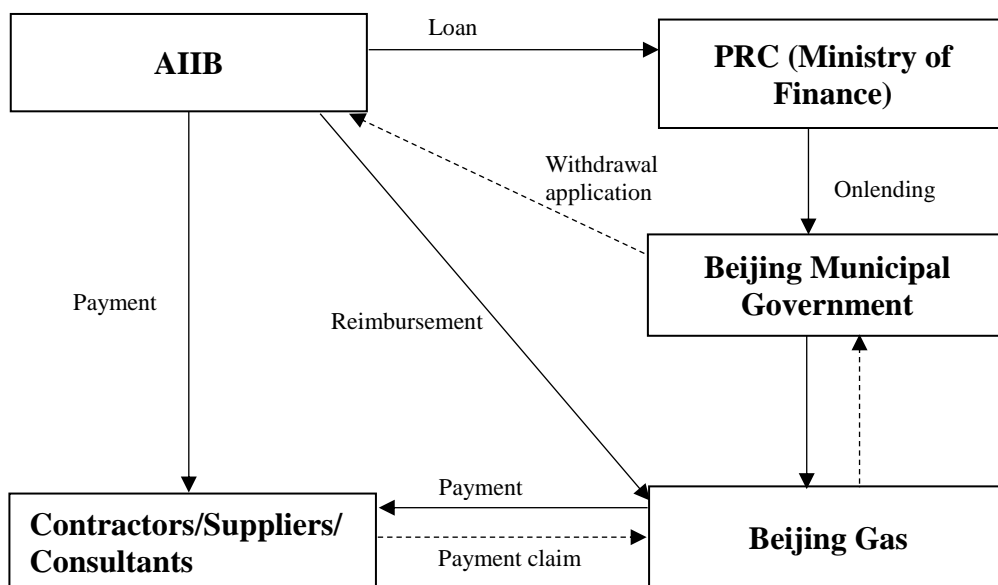
1. Beijing Gas will be responsible for overall project implementation and has set up a PMO to do the daily Project implementation work. Beijing Gas' Finance Department and the PMO are responsible for (i) overall Project construction management and monitoring; (ii) annual budget preparation and monitoring of utilization of loan proceeds; (iii) progress reporting, including reports on cost management and project outputs; and (iv) compliance with loan covenants. The PMO will also be responsible for procurement of goods and services, recruitment of consultants, and engineering and construction contractors. The Project management structure is in Figure A2.2.

C. Fund Flow Arrangement

2. The loan will be made to the People's Republic of China and will be onlent to Beijing Gas through the Beijing Municipal Government with its original terms and conditions.

3. The loan proceeds will be disbursed in accordance with the agreed arrangements between AIIB, Ministry of Finance and Beijing Gas. Multiple disbursement methods will be provided to accommodate the possible needs of the proposed Project, such as direct payment, advance payment, reimbursement (contract-based) and special commitment method if needed. Before the submission of the first withdrawal application, the Government of China should provide to AIIB sufficient evidence of the authority of the person(s) who will sign the withdrawal applications on behalf of the Government, together with the authenticated specimen signatures of each authorized person.

4. The following diagram shows the indicative funds flow arrangement.



Note: dotted line - document flow, hard line - fund flow

D. Allocation and Withdrawal of AIIB Loan Proceeds

No.	Item	Amount Allocated for AIIB Financing (\$ million)	Percentage and Basis for Withdrawal from the Loan Account
1	LNG facilities (contracts to be decided) under Component One of the Project	500.0	100% of total expenditure claimed
	Total	500.00	

Source: AIIB and Beijing Gas estimates.

E. Project Monitoring

5. Overall monitoring of the proposed Project in terms of progress will be undertaken by Beijing Gas. Beijing Gas will monitor physical progress, procurement, quality, contract management and financial management of the proposed Project.

6. **Compliance monitoring.** Loan covenants, such as legal, financial, economic, environmental, and others, will be monitored through the quarterly progress reports and review missions.

7. **Environmental and Social monitoring.** Beijing Gas and its PMO must adhere to the ESIA (including the ESMP) of the proposed Project agreed between AIIB and Beijing Gas during Project implementation, as agreed and/or endorsed by the Government of China. Beijing Gas will provide environmental and social monitoring reports to AIIB semi-annually during the construction period. The environmental and social monitoring reports will describe implementation progress of environment and resettlement activities and compliance issues and include quantitative monitoring data. In the event of any unanticipated environmental or social impacts during implementation, or if monitoring identifies a breach of performance standards that should be complied with by Beijing Gas and/or its contractors, Beijing Gas will submit to

AIIB a time-bound corrective action plan or updated the ESIA/ESMP.

F. Project Implementation Support Mission

8. AIIB will field regular implementation support missions every six months at a minimum to review the status of contract awards, disbursements, physical progress, and implementation of the environmental and social management plan. As necessary, special loan administration missions and midterm review missions will be fielded, under which any changes in scope or implementation arrangements may be required to ensure achievement of project objectives. Within 6 months after the closing date of the proposed Project, Beijing Gas will submit a Project completion report to AIIB. Following table explains the purpose and methodology to be used in the project review mission.

Mission	Purpose	Methodology	Responsibility
Implementation Support Mission	Review the progress of the Project and provide guidance to facilitate implementation	Site visits and meetings with Beijing Gas officials, contractors, consultants at least twice a year	AIIB and Beijing Gas
Midterm Review	Comprehensive review of the Project	With Government and Beijing Gas after 2 years of effectiveness	AIIB and Beijing Gas
Project completion report	Evaluate the overall output of the Project and its relevance and suitability	Site visit and meetings with Beijing Gas officials, contractors, consultants	AIIB and Beijing Gas

G. Reporting

9. Beijing Gas will provide AIIB with: (i) progress reports in a format consistent with AIIB's project performance reporting system and at a frequency as stated in the legal agreements; (ii) consolidated annual reports, including (a) progress achieved as measured through the performance indicators, (b) key implementation issues and solutions, (c) updated procurement plan and (d) updated implementation plan for the next 12 months; and (iii) a project completion report within 6 months after the closing date of the proposed Project. To ensure that the proposed Project continues to be viable and sustainable, the Project's accounts and Beijing Gas' financial statements will be audited annually. Such audit reports, together with the associated auditor's opinion, should be timely submitted and adequately reviewed.