FISCAL 2008 CDM/JI FEASIBILITY STUDY
PROVISIONAL REPORT
SUMMARY

Name of Study

CDM Project Study for Energy Utilization of Ammonia Plant Tail Gas in Syria

Organization

Shimizu Construction Co., Ltd.

1. Project Outline

(1) Host country / region

Homs City, Syrian Arab Republic

(2) Project Outline

The project site is an ammonia manufacturing plant located within a general chemical fertilizer complex (GFC) in Homs, the third largest city in Syria. The project is a CDM undertaking that aims to utilize purge gases (exhaust gas: CH_4 = 12%, H_2 = 60%, plus nitrogen, ammonia and argon, etc., but not including harmful substances) as an alternative fuel in the plant boiler. The project system currently being examined, as illustrated below, entails removing ammonia from the purge gas and then using a dedicated boiler to supply steam.

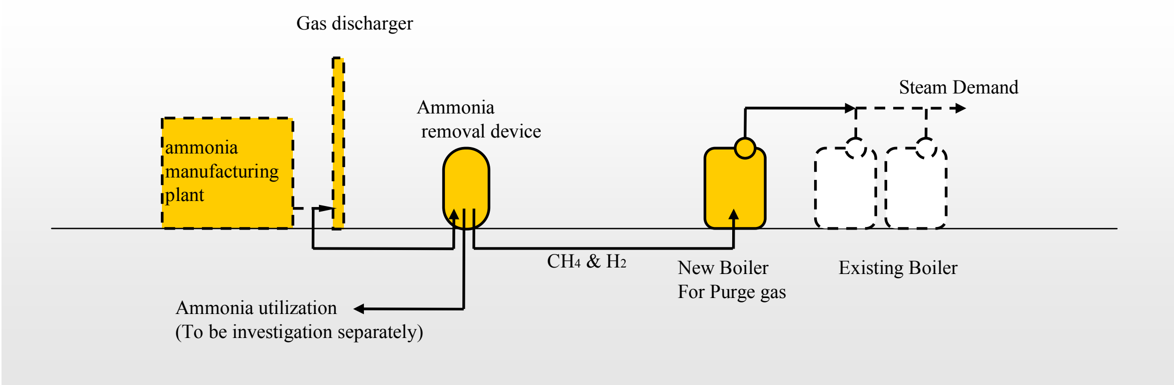


Figure 1 Project System Diagram

GFC has been searching for a way to make effective use of purge gas discharged from the ammonia plant for 20 years, however, it has failed to actualize this for the following reasons: ① introduction of technology from the United States has been difficult due to economic sanctions, ② no advanced country has been willing to transfer the technology required to combust and utilize purge gas, and ③ budget constraints have prevented GFC from introducing sophisticated equipment, and so on.

The estimated reduction in greenhouse gases, obtained by combining the portion destroyed by methane combustion and the portion obtained by reducing fossil fuels, is approximately 85,000 tons (converted to CO_2). In addition to realizing energy saving and GHG reductions through utilizing purge gas, this qualifies as a co-benefit-type CDM project since it will contribute to countering local pollution through preventing the atmospheric discharge of ammonia, which is a harmful substance.

The project owner is GFC, however, since it cannot procure the funds necessary for making the initial investment, it will be effective to adopt a project scheme based on burden of the initial investment by the Japanese side.

Considering that existing methodology cannot be applied to this project, it is essential to propose and approve a new methodology, and since it will take at least six months for the new methodology to be approved, the start of the project is expected to be around January 2011.

Purge Gas Discharge Stack

Main Parts of the GFC (ammonia plant is left of center)

2. Contents of the Study

(1) Issues in the Study

- Past data concerning purge gas discharge (purge gas flow, composition of gas, etc.)
- The contents and findings so far independently investigated by GFC concerning the utilization of purge gas
- Actual performance and future prediction regarding the heat source system and demand for heat at the ammonia plant
- Feasibility of power plant installation in GFC
- Purge gas properties, characteristics of the utilizing equipment, feasibility of use in gas engines, etc.

- Availability of methodology applicable to the project
- Monitoring items and monitoring plan for the project
- Calculation of greenhouse gas reductions in the project
- Status of the project under the legal system in Syria; necessity for EIA
- Comments from stakeholders in the project
- Involvement of the GFC in the project
- Possibility of fundraising by the GFC for the CDM project
- Price of credits that will enable the project to be viable
- Whether or not the Government of Syria will approve the project as a CDM undertaking
- Points in which the proposed project can contribute to sustainable development in the host country
- Basic information concerning the Syrian Arab Republic with respect to project implementation

(2) Study Implementation Setup

- Ohsumi Co., Ltd. : Environmental impact assessment, site survey, local information collection
- Climate Experts PLC. : Support for creation of new methodology and PDD preparation
- General Fertilizer Company (GFC) : Local counterpart; provision of local information and past operating data, etc.

(3) Contents of the Study

Field surveys were implemented in the shape of the preliminary survey from August 31 to September 4, the first field survey from November 16 to November 20, and the second field survey from January 31 to February 5. The second field survey is scheduled for implementation at the end of January.

The following points have mainly been confirmed in the field surveys:

- The outline, objectives, setup and schedule of the Study and the study scheme of the Japanese Ministry of Environment were explained to the Ministry of Local Administration and Environment (the DNA in Syria) and the counterpart GFC (General Fertilizer Company). After understanding was obtained, future cooperation was confirmed.
- In GFC, upon discussing the concrete purge gas utilization method and surveying the site, the system for supplying steam to the ammonia manufacturing process was deemed to be the best option.
- Various ideas and opinions concerning uses of purge gas were forthcoming from the local side and, although there was some opposition to the system proposed by the Japanese side, understanding was obtained upon explaining the difficulty of preparing a new methodology and conducting monitoring.
- Documents and so on were collected as evidence of past efforts to utilize purge gas in order to ascertain the reasons why purge gas has not been used in GFC so far.

- Opinions on the project were exchanged with the Ministry of Industry, which has supervision over GFC, and its support was confirmed
- The PIN was prepared on the Japanese side and was submitted from GFC to the Ministry of Industry.
- Information was also shared with the Japanese Embassy and the JICA Office in Syria so that support can be received whenever necessary.
- Discussions were held and agreement was reached concerning conclusion of the MOU geared to future activities.

In particular, examination and exchange of opinions was carried out concerning the mean flow of purge gas, concentration of methane gas and disparities with design values in the discussions with GFC, and discussions were held concerning a number of potential effective uses of purge gas energy including power generation and so on.

First, concerning power generation, although there is ample demand for generated electricity in the plant, the utilization of purge gas as fuel in a gas engine presents technical difficulties. Moreover, since it is technically difficult to introduce gas turbines to Syria, the only feasible power generation system is steam turbine generation; however, because the quality control of steam condensate presents technical difficulties in Syria where water resources are precious, utilization for power generation may be difficult.

Concerning boiler steam and hot water utilization, the system for high pressure steam from the natural gas boiler is a viable source of demand for the estimated steam flow from purge gas in the ammonia manufacturing plant. It was initially thought that the fuel oil boiler was a promising destination for steam from the viewpoint of pollution prevention, however, it is not feasible because it does not have sufficient demand for steam and it is situated too far away from the purge gas generation area.

The project system was determined upon taking the above points into account.

Issues in the study are as follows:

- Past data concerning purge gas discharge (purge gas flow, composition of gas, etc.)

  →Data was collected from randomly sampled days over the past year. It was found that, since the system load factor is around 80% compared to the initial design value, methane gas concentration is lower than the design value.

- The contents and findings so far independently investigated by the GFC concerning the utilization of purge gas

  → GFC has attempted to devise a method for using purge gas as fuel in the ammonia manufacturing process together with the plant design company Kellog Co. in recent years, however, this hasn't been successful. Meanwhile, utilization as boiler fuel as proposed here has not been realized because the low price of fuel detracts from the economic merits.

- Actual performance and future prediction regarding the heat source system and demand for heat at the ammonia plant

  → In order to satisfy the overall demand for heat in the ammonia manufacturing plant, two boilers with rated steam generation flow of 60 t/h are operating with natural gas as fuel. These boilers usually operate in tandem at around 70% load and they possess sufficient heat demand to utilize purge gas as fuel. The demand for heat varies according to the manufactured amount of ammonia, however, since the amount of ammonia is expected to remain the same into the future, the heat demand will also be the same.

- Feasibility of power plant installation in GFC

  → In addition to utilization as boiler heat, purge gas can be used as generated electric power. Upon surveying the feasibility of installing a power plant in GFC, since it is difficult to introduce steam turbine generation due to the scarcity of water in Syria, and likewise gas turbine generation in view of technical levels in that country, the only feasible alternative is power generation based on a gas engine.

- Purge gas properties, utilizing equipment characteristics, feasibility of use in gas engines, etc.

  → Since purge gas is a composite gas comprising methane and hydrogen, it has been found to be unsuitable for gas engine combustion in terms of the combustion speed and flame.

- Availability of methodology applicable to the project

  → The project entails reduction of greenhouse gases in two ways, i.e. destruction of otherwise discharged methane and substitution of existing fuel; however, no existing methodology simultaneously deals with these two components. Accordingly, a new methodology will need to be prepared.

- Monitoring items and monitoring plan for the project

  → In preparing the new methodology, the simplest and clearest possible monitoring method will be proposed. Specifically, monitoring based on direct measurements will be adopted while calculations based on past data, etc. will be avoided in order to realize monitoring that is clear to anyone. Details are described later on.

- Calculation of greenhouse gas reductions in the project

  → Based on past operating performance and future operating plans, the quantity of purge gas, ratio of methane in purge gas and recoverable heat quantity from purge gas will be calculated, and the quantity of greenhouse gas emission reductions will be computed from ① methane destruction and ② fuel substitution in the existing boilers.

- Status of the project under the legal system in Syria; necessity for EIA

  → Law No.50 (Environmental Law) constitutes the legislation concerning air pollution in Syria. The Environmental Law comprises the following legislation:

- Law on Nature Protection,
- Law on the Protection of Ambient Air,
- Law on Water and Water Use,
- Law on Environmental Assessment, and
- Strategy and National Environmental Action Plan, etc.

Meanwhile, specific regulations concerning air pollution are prescribed in the National Ambient Air Quality Standards and the Maximum Emission Limits of Pollution Parameters at Source.

According to the above laws, there are non regulations enforced with respect to purge gas emissions. Accordingly, maintenance of status quo can be adopted as the baseline scenario.

Concerning the necessity of EIA, the project plan here does not fall under the list of projects deemed to require EIA. Moreover, since this is an environmental consideration project geared to limiting the generation of ammonia, the department in charge of EIA within the Ministry of Local Administration and Environment has intimated that implementation of an EIA won't be necessary.

- Comments from stakeholders in the project

  → The Syrian government defines the stakeholders as the Technical Committee. Since the committee will hold discussions based on the PDD, it is not possible to obtain any official comment at the present time, however, in interviews conducted with key committee members during the survey, positive comments were obtained regarding the project.

- Involvement of GFC in the project

  → GFC employs numerous engineers and is very enthusiastic about the project. However, although the local engineers possess knowledge and know-how concerning operation and improvement of the existing system, they only have limited know-how concerning CDM projects so it will be essential to conduct capacity building in this respect.

  When it comes to implementing the project, the Japanese side will need to take the initiative regarding CDM project formation procedures such as new methodology preparation, PDD preparation and United Nations registration; however, concerning subsequent operation and maintenance, it is planned for the GFC side to bear the main responsibility upon conducting transfer of technology from Japan.

- Possibility of fundraising by GFC for the CDM project

  → GFC directors and officials were interviewed concerning the ability of GFC to raise funds for procuring project equipment and implementing the project under the CDM; however, because GFC is a state-owned enterprise, even though it isn't impossible to secure budget for a new CDM project, it is forecast that the budget application procedure would take a very long time. Accordingly, it was concluded that fundraising by GFC to cover the initial investment is not feasible. As a result, the project is planned based on the assumption of direct funding by Japanese investors regarding the initial investment.

Meanwhile, concerning operation and maintenance following the start of the project, since this can be handled by GFC except for the procurement of special parts, it is planned to continue discussions concerning the specific division of roles in the future.

- Price of credits that will enable the project to be viable

  → Since direct investment will need to be relied on in order to raise funds, it will be necessary to repay the initial investment in around five years. Assuming the initial investment to be around 300 million yen, the minimum credit price calculated from the forecast annual amount of credits works out as US$10/ t-$CO_2$e.

- Whether or not the Government of Syria will approve of the project as a CDM undertaking

  → The General Commission for Environmental Affairs (GCEA), which is a subordinate organization of the Ministry of Local Administration and Environment, has been selected as the DNA in Syria.

  The project planners will first submit the PIN to the DNA, however, this document is not intended to secure approval. Approval is obtained through submitting the PDD for review to the Technical Committee and the Consultant Committee. The Technical Committee, which reviews specific technical items, comprises personnel section manager class in government ministries and agencies and is chaired by the Director of the GCEA (Vice Minister of Local Administration and Environment). Meanwhile, the Consultant Committee is composed of ministerial level personnel and is chaired by the Minister of Local Administration and Environment.

  So far the government has granted approval to two projects.

  There are no particular requirements stipulated for projects but rather it will be necessary to coordinate requirements with the DNA; however, since the project has already been explained to the DNA, it is expected to receive approval as a CDM project.

- Proposed project contributions to sustainable development of the host country

  → In Syria, as in other developing countries, increasing demand for gasoline and other forms of energy is a major issue, and recent inflation in fossil fuels is starting to have an impact on GFC too.

  For an agricultural nation such as Syria, GFC is the country's sole chemical fertilizer plant and it is important to control fertilizer price inflation from the viewpoint of agricultural policy too. Therefore, since the project proposes to effectively utilize purge gas as a clean substitute fuel, it can make a contribution to the sustainable development needs of Syria from the viewpoints of mitigating air pollution, conserving energy and stabilizing citizen lifestyles through the stabilization of fertilizer prices.

  Moreover, for Syria, which has fewer energy resources than other Middle Eastern states, the promotion of energy saving including utilization of renewable energy is an extremely important issue. Accordingly, the project, which proposes to utilize purge gas that couldn't be utilized until now for technical reasons, will contribute to sustainable development from the added viewpoint of technology transfer from an advanced country.

Furthermore, since the project will entail the recovery of ammonia, which is harmful to the human body and is currently discharged into the atmosphere, it will also contribute to Syrian needs concerning the mitigation of air pollution.

- Basic information concerning the Syrian Arab Republic with respect to project implementation

→ The Syrian Arab Republic ratified the Framework Convention on Climate Change on January 4, 1996 and the Kyoto Protocol on September 4. This represents a recent change in policy towards positive participation in the Kyoto mechanism. The government places a lot of anticipation in overseas investment based on CDM projects and is supportive of the Kyoto Protocol. In particular since Japan is an important donor nation, the government wishes to promote projects with Japanese corporations.

For Syria, since the strained energy demand and supply situation and environmental problems such as air pollution, etc. are pressing issues, the government is pinning a lot of hope on promotion of energy saving, use of renewable energies and local environmental improvement based on CDM utilization.

Interest in energy saving and renewable energies and unused energies such as solar power and wind energy, etc. has been growing in Syria in recent years, and the Syrian government is building a system for the preferential purchase of electricity derived from renewable energies.

In addition, basic information concerning recent trends, social systems and industrial trends, etc. has been collected and organized to aid judgment regarding the timing of project implementation and investment.

3. Project Actualization

(1) Setting of the Project Boundary and Baseline

The physical project boundary in the proposed new methodology is "The area of GFC where purge gas is recovered and used as boiler fuel." In the project, it is planned to recover purge gas in the ammonia plant and to install a new multi-fuel fired boiler next to the two existing natural gas fired boilers. Therefore, the project boundary is limited to this area.

Moreover, the gases and emission sources contained in the project boundary are as follows.

Table Outline of Gases and Emission Sources Within the Project Boundary

	Emission Source	Target Gas	Contained or Not	Validity / Explanation
Baseline	Purge gas discharge (no flaring or other treatment)	CH_4	Contained	This is the main generation source in the baseline.
Baseline	Purge gas discharge (no flaring or other treatment)	N_2O	Not contained	Purge gas contains hardly any N_2O. This is not considered in order to be on the conservative side.
Baseline	Purge gas discharge (no flaring or other treatment)	CO_2	Not contained	CO_2 in the purge gas is a common emission source in both the baseline scenario and project activities (emissions are equal). Therefore, it is not considered.
Baseline	Combustion of the boiler baseline fuel (corresponding to the fuel substituted by the purge gas)	CO_2	Contained	This is a major generation source in the baseline.
Baseline	Combustion of the boiler baseline fuel (corresponding to the fuel substituted by the purge gas)	CH_4	Not contained	This is not considered out of interests of preserving simplicity and to be on the conservative side.
Baseline	Combustion of the boiler baseline fuel (corresponding to the fuel substituted by the purge gas)	N_2O	Not contained	This is not considered out of interests of preserving simplicity and to be on the conservative side.
Project Activities	Combustion of the purge gas utilized in the project activities	CO_2	Contained	CO_2 from destruction of hydrocarbons (almost all methane) contained in the purge gas
Project Activities	Combustion of the purge gas utilized in the project activities	CH_4	Not contained	Not considered for simplification and because the quantities are negligible
Project Activities	Combustion of the purge gas utilized in the project activities	N_2O	Not contained	Not considered for simplification and because the quantities are negligible
Project Activities	Electric power consumed for removal of ammonia contained in the purge gas	CO_2	Contained	This is considered to be an important source of emissions.
Project Activities	Electric power consumed for removal of ammonia contained in the purge gas	CH_4	Not contained	This is hardly contained at all following combustion. It is not considered for the sake of simplification.
Project Activities	Electric power consumed for removal of ammonia contained in the purge gas	N_2O	Not contained	Purge gas contains hardly any N_2O. It is not considered for the sake of simplification.

It is expected that the baseline scenario is maintenance of the status quo.

(2) Monitoring Plan

Major monitoring items are currently assumed to be as follows.

Item	Explanation
$AOG_{Total,y}$	Total quantity of standard state purge gas (following ammonia collection) used in the project activities
w_{CH4}	Methane content of purge gas (after the ammonia collection equipment)
T	Temperature (attached to the flow meter) of purge gas (following ammonia removal)
P	Pressure (attached to the flow meter) of purge gas (following ammonia removal)
$NCV_{AOG,y}$	Net heating value of purge gas (after the ammonia collection equipment)
$NCV_{NG,y}$	Lower heating value of natural gas combusted with purge gas
$EF_{\mathrm{CO2,BLf}}$	Emission coefficient of CO_2 in the baseline fuel (natural gas in this project) that would be used if the project weren't implemented
$EF_{CO2,AOG,y}$	Emission coefficient of CO_2 in purge gas (after the ammonia collection equipment)
$EC_{pc,y}$	Electric power consumed in collection of ammonia
$CEF_{EL,y}$	Emission coefficient of CO_2 per unit electric energy of power consumed in the ammonia collection equipment.
$Q_{project\ ,y}$	Net heating value of steam produced by the project fuel (purge gas after the ammonia collection equipment)
$\varepsilon_{PJboiler}$	Thermal efficiency of the boiler (purge gas boiler) in the project scenario
$\varepsilon_{BL,boiler}$	Thermal efficiency of the boiler in the case where the project isn't implemented

The project participants on the Japanese side will carry out the initial project investment (ordering of construction works), however, the GFC will bear full responsibility for all other project operation and management (monitoring, facilities operation and maintenance, accounting, CER management, subcontracting, personnel affairs, reporting, etc.).

In the project, quality control and quality assurance will be carried out by the following methods.

- The project implementing organization will consist of operating personnel and management.
- Management will prepare written procedures for operating facilities.
- Written procedures, containing daily work contents, periodic maintenance methods and judgment criteria, etc., will be compiled according to appropriate formats.
- Management will check reports from operating personnel and determine there are no problems according to the procedures. If problems are found in such checks, management will implement the appropriate countermeasures with appropriate timing.
- Management will everyday file and store reports from operating personnel according to the procedures.
- In the event of accidents (including monitoring equipment failures and malfunctioning of the logging system), management will ascertain the causes, implement and instruct countermeasures to the operating personnel.

- In cases of emergency (including monitoring equipment failures and malfunctioning of the logging system), operating personnel will take stopgap measures and implement countermeasures according to instructions from management.
- Measuring instruments will be periodically and appropriately calibrated according to the procedures. Calibration timing and methods will be in accordance with monitoring plan.
- Measured data will be subject to audit by government agencies in the host country. Also, the GFC will conduct internal audits according to necessity and strive to enhance the accuracy of monitoring data.

(3) Greenhouse Gas Emission Reductions

Since there is no need to consider leakage in the project activities, emission reductions will be calculated according to the following expression based on the proposed new methodology:

ERy = BEy –PEy

ER_y	Emission reductions	tCO_2e
BE_y	Baseline emissions	tCO_2e
PE_y	Project emissions	tCO_2e

PEy = QAOG,y * EFCO2,AOG,y /1000+ ECpc,y * CEFEL,y

With,

$Q_{AOG,y} = AOG_{Total,y} * NCV_{AOG,y}$

PE_y	Project emissions	tCO_2e
$Q_{AOG,y}$	Net heating value of purge gas (after the ammonia collection equipment) used in the project activities	GJ
$EF_{CO2,AOG,y}$	CO_2 emission coefficient of purge gas (following ammonia collection)	tCO_2/GJ
$EC_{pc,y}$	Electric power consumed in collection of ammonia	MWh
$CEF_{EL,y}$	CO_2 emission coefficient per unit amount of electric power consumed in ammonia collection	tCO_2/MWh
$AOG_{total,y}$	Total quantity of standard state purge gas (following ammonia collection) used in the project activities	m^3
$NCV_{AOG,y}$	Net heating value of purge gas (after the ammonia collection equipment)	GJ/m^3

BEy= MDproject,y *GWPCH4 + QAOG,y* (εPJboiler/εBLboiler) * EFCO2,BL f /1000

With,

MDproject,y= AOGtotal,y* wCH4* DCH4

QAOG,y= AOGTotal,y* NCVAOG,y

BE_y	Baseline emissions	tCO_2e
$MD_{project,y}$	Total quantity of methane destroyed in the project activities	tCH_4
GWP_{CH4}	Warming coefficient of methane in the first commitment term	tCO_2e/tCH_4
$Q_{AOG,y}$	Net heating value of purge gas (following the ammonia collection equipment) used in the project activities	GJ
$EF_{CO2,BLf}$	Emission coefficient of CO_2 in the baseline fuel	tCO_2/GJ
$\varepsilon_{BLboiler}$	Thermal efficiency of the boiler in the case where the project isn't implemented	—
$\varepsilon_{PJboiler}$	Thermal efficiency of the boiler in the project scenario	—
$AOG_{total,y}$	Net total quantity of purge gas (following ammonia collection) used in the project activities	m^3
w_{CH4}	Methane content of purge gas (after the ammonia collection equipment)	m^3CH_4/m^3AOG
D_{CH4}	Methane density	tCH_4/m^3CH_4
$NCV_{AOG,y}$	Net heating value of purge gas (after the ammonia collection equipment)	GJ/m^3
$Q_{project,y}$	Net heating value of steam produced by the project fuel	GJ

The results of estimating emission reductions in the project are given in the following table. The estimation was based on the following assumptions:

- The ammonia plant is operated at 100% load.
- Rated output of the multi-fuel fired boiler introduced in the project is the same as the existing natural gas fired boiler, and it operates at 100% load.
- Annual operating time is 7,680 hours (320 days, 24 hour operation)

Moreover, it should be noted that these figures are estimate values and not actual emissions and emission reductions. Actual emission reductions will be directly measured in the monitoring.

Table Results of Trial Calculation of Emissions and Emission Reductions

Year (month)	Estimated project emissions (tCO_2 e)	Estimated baseline emissions (tCO_2 e)			Estimated leakage (tCO_2 e)	Total estimated emission reductions (tCO_2 e)
		Methane destruction	Fuel reduction	Total		
2011 (1-12)	8,004	58,926	34,328	93,254	0	85,250
2012 (1-12)	8,004	58,926	34,328	93,254	0	85,250
2013 (1-12)	8,004	58,926	34,328	93,254	0	85,250
2014 (1-12)	8,004	58,926	34,328	93,254	0	85,250
2015 (1-12)	8,004	58,926	34,328	93,254	0	85,250
2016 (1-12)	8,004	58,926	34,328	93,254	0	85,250
2017 (1-12)	8,004	58,926	34,328	93,254	0	85,250
2018 (1-12)	8,004	58,926	34,328	93,254	0	85,250
2019 (1-12)	8,004	58,926	34,328	93,254	0	85,250
2020 (1-12)	8,004	58,926	34,328	93,254	0	85,250
Total (tCO_2 e)	80,040	589,260	343,280	932,540	0	850,250

Moreover, estimated values of parameters used in the estimation of emission reductions are as follows.

Table Estimated Values of parameters used in Estimation of Emissions

Parameter		Estimated Value	Unit
Operating time	OH	7680	hr/yr
Total quantity of purge gas (following ammonia collection) used in the project activities	$AOG_{total,y}$	65241600	Nm^3
Methane content of purge gas (after the ammonia collection equipment)	w_{CH4}	0.060	Nm^3CH_4/Nm^3AOG
Maximum methane content of purge gas (after the ammonia collection equipment) * In case of wCH4> wCH4,max, baseline emissions (methane part) are capped at wCH4,max ($w_{CH4} = w_{CH4,max}$).	$w_{CH4,max}$	0.120	Nm^3CH_4/Nm^3AOG
Methane density	D_{CH4}	0.0007168	tCH_4/Nm^3CH_4
Warming coefficient of methane in the first commitment term	GWP_{CH4}	21	tCO_2e/tCH_4
Lower heating value of purge gas (after the ammonia collection equipment)	$NCV_{AOG,y}$	0.0094	GJ/Nm^3
Heating value (net heating value) of purge gas (after the ammonia collection equipment) used in the project activities	$Q_{AOG,y}$	613000	GJ
Net heating value of natural gas used as the baseline fuel	$NCV_{BLf,y}$	0.0363	GJ/Nm^3
Thermal efficiency of the boiler in the project scenario	$\varepsilon_{PJ,boiler}$	0.800	-
Thermal efficiency of the boiler in the baseline scenario	$\varepsilon_{BL,boiler}$	0.800	-
CO_2 emission coefficient of baseline fuel (natural gas in the project)	$EF_{CO2,BLf}$	56.0	tCO_2/TJ

Parameter		Estimated Value	Unit
CO_2 emission coefficient of purge gas (after the ammonia collection equipment)	$EF_{CO2,AOG,y}$	9.8	tCO_2/TJ
Electric power consumed in the ammonia collection equipment	$EC_{pc,y}$	1536	MWh
CO_2 emission coefficient per unit amount of electric power consumed in the ammonia collection equipment	$CEF_{EL,y}$	1.3	tCO_2/MWh
Total quantity of methane destroyed in the project activities	$MD_{project,y}$	2806	tCH_4/yr
Baseline emissions (total)	BE_y	93254	tCO_2/yr
Project emissions	PE_y	8004	tCO_2/yr
Emission reductions	ER_y	85250	tCO_2e/yr

(4) Project Period and Crediting Period

The service life of equipment to be introduced in the project is around 15 years, and this may also be considered as the project implementation period.

As for the crediting period, this is assumed to be 14 years (7 years x 1 renewal = 14 years) based on the project implementation period.

However, in line with the bolstering of efforts to counter global warming in the future, it is unlikely that the discharge of purge gas, i.e. maintenance of the status quo, will be the baseline in 7 years. Accordingly, it is more realistic to assume a crediting period of 10 years (10 years x no renewal = 10 years).

The next step towards project realization will be to secure United Nations approval for the new methodology. Following that, the PDD will be finished, validation will be implemented and procedures for securing United Nations registration will be conducted. When registration is completed, the equipment installation works will be implemented and the operation stage will be entered.

Even assuming that United Nations approval procedure for the new methodology starts in April 2009, considering the current situation regarding deliberations in the UN, it will take at least nine months. Accordingly, the earliest that validation can start will be January 2010.

As of January 2009, it takes a minimum of around nine month from validation to United Nations registration, and this is because at least three months are needed for clerical checking when making the application. If this checking procedure can be improved, it should be possible to complete the UN registration by June 2010, and since the works will be commenced from this time, the project start date should be around July 2010.

(5) Environmental Impact and Other Indirect Impacts

The project will have a beneficial impact on the environment because it will effectively utilize methane gas that is currently discharged into the atmosphere and also will reduce the quantity of fuel consumption. Moreover, examination is being given to simultaneously introducing equipment for recovering ammonia contained in the purge gas, and this will also have a beneficial environmental impact.

In the Syrian Arab Republic, requirements concerning environmental impact analysis are prescribed according to each type of project. However, nothing is prescribed concerning this project because it is a wholly new type. Accordingly, as a result of holding discussions with the General Commission for Environmental Affairs (GCEA), which is responsible for environmental administration, it seems that there will be no need to implement an EIA for the project.

Other indirect impacts include transfer of technology, development of human resources and employment creation during the construction works and operation stages, and economic income (expenditure reduction) enabled by fuel reduction in the operation stage.

Meanwhile, it is expected that there will be increased vehicle traffic, noise and vibration, etc. during the construction works, however, since construction is only scheduled to last two or three months and the amount of noise and vibration will be equivalent to that generated in ordinary construction works, this is not considered especially to be a problem.

(6) Stakeholders' Comments

The DNA in Syria is the GCEA under the jurisdiction of the Ministry of Local Administration and Environment. The DNA defines the stakeholders as the Technical Committee, so the committee's opinion will represent the stakeholders' opinion. The Technical Committee is composed of members from the following organizations.

a) General Commission for Environmental Affairs (GCEA).
b) Ministry of Transportation.
c) Ministry of Petroleum.
d) Ministry of Electricity.
e) National Energy Research Center (Ministry of Electricity).
f) Ministry of Industry.
g) Ministry of Local Administration and Environment.
h) Country Planning Commission.

Since the Technical Committee will be staged following completion of the PDD, in this study, interviews were held with the committee members who are directly concerned with the project. The comments received were as follows.

① General Commission for Environmental Affairs (GCEA): Mr.Haitham Nashawati

- This represents the first CDM project in the industrial sector in Syria, and the DNA welcomes the spread of CDM projects to other sectors in this way.
- The planning for this project has triggered active desire to promote CDM within the Ministry of Industry. Such a trend conforms with the policies of Syria and the project significance is great
- This project offers an effective guard against pollution through preventing discharge of ammonia into the atmosphere, and it is also effective in terms of preventing global warming. As the DNA, we intend to actively promote the development of this type of co-benefit CDM project in future.
- Considering the high regard with which the Syrian DNA holds the project and its desire to offer positive support, the earliest possible realization of the project is desired.
- Private conversations with a number of Technical Committee members revealed they have a positive attitude towards the project.

② Ministry of Industry: Ms. Amal Hasan

- The Ministry of Industry considers it problematic that a precious source of energy such as purge gas is being wastefully discharged and that ammonia emissions are adversely impacting the air environment in GFC. Accordingly, we welcome this project which addresses these problems.
- There are a number of potential CDM project sites involving energy saving measures and so on in Syrian plants, and the Ministry of Industry is ready to offer full support to this project as a pioneering case.
- The Ministry of Industry only has positive things to say about the project.

Based on the above comments, it was found that the Syrian government and the Technical Committee, which represents the stakeholders, are generally in favor of the project.

(7) Project Implementation Setup

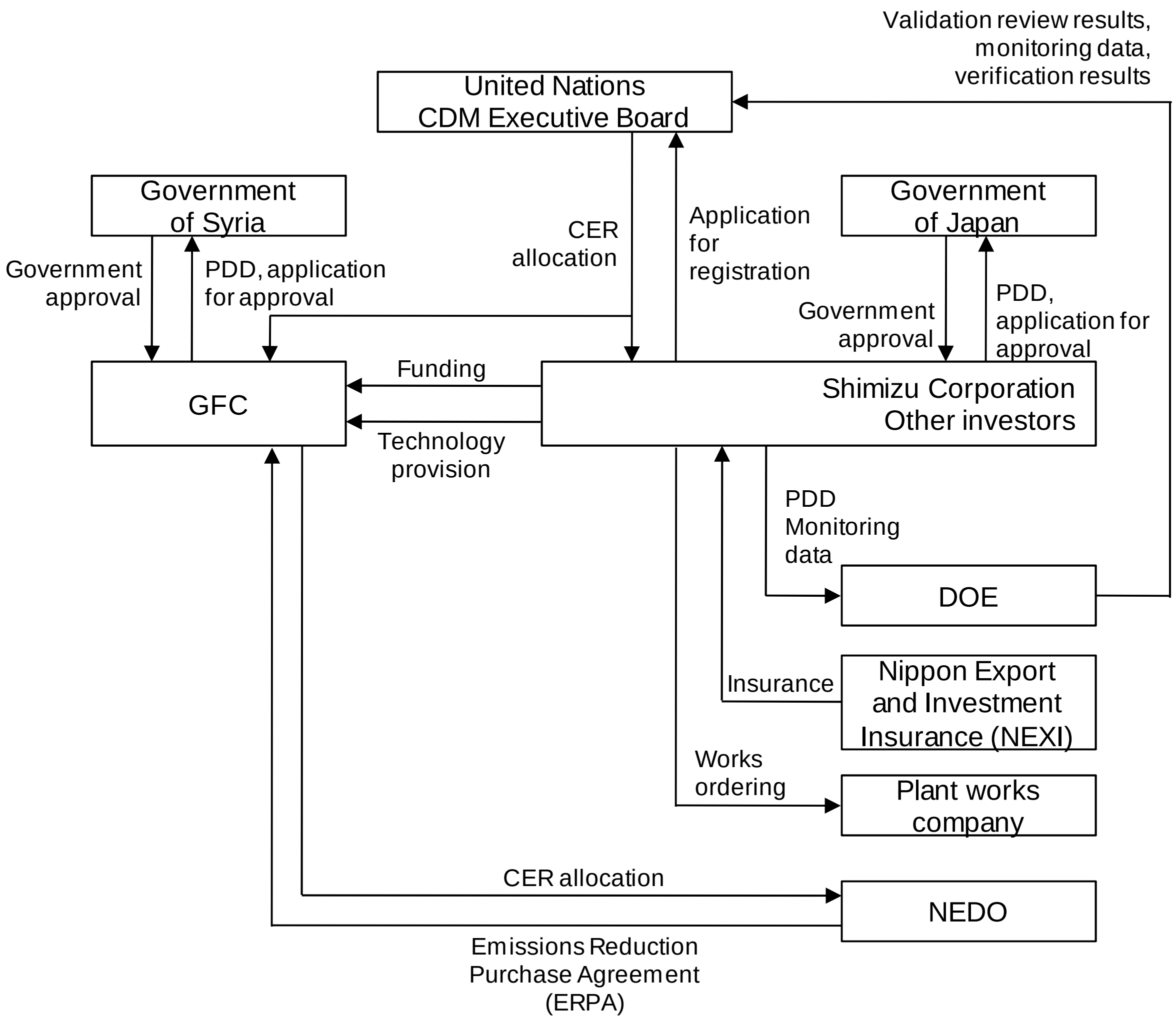


Figure　Project Implementation Setup

In the project, the participants on the Japanese side will carry out the initial project investment (ordering of construction works), however, the GFC will bear full responsibility for all other project operation and management (monitoring, facilities operation and maintenance, accounting, CER management, subcontracting, personnel affairs, reporting, etc.).

The main duties of the Japanese participants will be composition of the project (including funding), planning of implementation and transfer of technology.

Project composition includes the securing of approval for the new methodology, preparation of the PDD and United Nations registration, etc. which are essential for implementing the project as a CDM undertaking.

The actual operating body in the project will be the GFC company. This company will be wholly responsible for the project operation and management (monitoring, facilities operation and maintenance, accounting, CER management, subcontracting, personnel affairs, reporting, etc.). At this time, the Japanese project participants will conduct technical guidance and so on.

Moreover, concerning the site installation works for equipment and auxiliary instruments, it is scheduled to order work to local subcontractors.

(8) Fund Plan

Concerning the fundraising method, it is possible to combine investment from investors (participating corporations), subsidies from government agencies, etc. and finance by public and private financial institutions.

However, since initial investment in this project is relatively small at around 300 million yen, direct investment (fundraising) by investors is the most viable alternative. The project participating companies including Shimizu Corporation are willing to raise funds for the project, and it will be possible to secure the necessary funding from these sources.

Accordingly, it is expected that funds will be provided at the start of the construction works, and that project development expenses up to that point will be borne by the participating enterprise.

Running costs following the start of operation will be covered through selling off credits.

(9) Economic Analysis

Project profitability will be assessed in terms of the investment recovery period and the internal rate of return (IRR). The prerequisites for conducting evaluation are set as shown in Table 7.1.1.

The initial cost is 2,900,000 US$. On adding the validation review and registration expenses, project development cost and other initial expenses, the initial investment amounts to 3,155,550 US$.

Concerning running costs, it is estimated that the maintenance cost will be 145,000 US$/year, operating cost will be 45,500 US$/year, and monitoring, verification and registration expenses will be around 95,550 US$/year.

As for taxes, a profit tax of 20% on profits will be considered.

Concerning depreciation, plant depreciation will be calculated as 90% straight line depreciation over 10 years.

Concerning the project revenue, income from the sale of credits and reduction of fuel costs arising from reduced use of natural gas can be considered. The fuel cost saving is expected to be 337,741US$/year.

Concerning the investment recovery period and internal rate of return, 1) the number of years required for the project cumulative balance to enter the black following the start of the project (start of operation), and 2) the project IRR over the project period (10 years), are calculated in four scenarios, i.e. the case where CERs have no economic value, and the cases where CERs are worth 5 US$/t$CO_2$, 10 US$/tCO_2 and 15 US$/t$CO_2$ respectively.

The results of analysis are indicated below.

Economic Value of CERs		IRR	Investment Payback Period
Case where CERs have no economic value	0 US$/$tCO_2$	Minus	Irrecoverable
Cases where CERs have economic value	5 US$/$tCO_2$	6.23	8 years
	10 US$/$tCO_2$	20.71	5 years
	15 US$/$tCO_2$	33.09	3 years

(10) Demonstration of Additionality

As was indicated earlier, the baseline scenario is expected to be maintenance of the status quo.

The baseline scenario will basically be demonstrated through grasping how things have actually been within GFC from the past to present and presenting reasons and evidence to support this.

Conditions so far can be summarized as follows:

- Purge gas is currently not effectively utilized but is entirely discharged into the atmosphere.
- GFC has tried to make effective use of purge gas, however, these efforts have been unsuccessful for various reasons.

Various reasons specifically refer to the following:

- Lack of technical capacity within GFC itself [it doesn't possess the technology for appropriately combusting low calorie purge gas, neither does it have more sophisticated membrane separation technology. Moreover, it does not possess technology for dealing with ammonia combustion or removing NOx from the purge gas].
- Kellogg Co., which is seeking the provision of technology from external sources, has been unilaterally suspended due to economic sanctions imposed by the United States, and it has not received cooperation from any other advanced countries either.
- The price of natural gas is artificially held to a lower level than in other countries, thereby making it difficult to secure economic incentives.

In reality, GFC is operating well below design values even in its primary business of ammonia manufacture, while only low priority has been applied to such a minor areas as the effective utilization of purge gas.

Regarding existence of barriers like those described above, evidence is being collected and a chronological table is being compiled with a view to tracking the decision making by the GFC.

Concerning actual proof, a number of baseline scenarios different from maintenance of the status quo are presented and the most likely one (in the case where the CDM project is not implemented) is selected as the baseline scenario. In this case, the project is divided into two major components, and the separate scenarios (combinations) are examined within these:

- Method of purge gas treatment/utilization
  > Project activities
  > Maintenance of status quo
  > Flaring
  > Uses other than for steam
  > Utilization as raw materials
  > Sale of purge gas

- Supply source of heat (produced in the project)
  > Project activities
  > Maintenance of status quo
  > Utilization of fossil fuels not used at present

As was described earlier, maintenance of the status quo is the baseline scenario and it can be demonstrated that the project is additional.

(11) Prospects for and Issues in Project Realization

The Government of Syria has already finalized its setup and procedure for giving approval to CDM projects, and state approval has already been granted to two such undertakings.

The project in hand is highly regarded by the government and is likely to receive approval in Syria.

The project counterpart GFC welcomes project implementation because of the environmental improvement and overseas investment it will bring, and it offered a lot of cooperation to this feasibility study.

In the project, it is expected to secure CERs from 2011 and, providing that the price of CERs is 10US$/t$CO_2$ or more, the project should be economically viable.

However, it will be necessary to prepare a new methodology and obtain approval from the United Nations for this. Since clerical procedures starting from application for registration are extremely conservative in the United Nations, there is concern that this could hold up the project implementation schedule.

In the study, considering that this is a completely new type of CDM project, in addition to surveying the current conditions and past developments of the counterpart, the prospects for creating a new methodology were surveyed and it was possible to build a relationship of trust with the counterpart.

The Middle East region has so far displayed a negative attitude towards reducing greenhouse gas emissions, however, some countries are starting to indicate a positive attitude due to the potential for attracting foreign investment. From now on it will be necessary to quickly realize the project, build a sound implementation record, continue developing projects in the Middle East region and connect these activities to the realization of Japan’s goals.

Shimizu Corporation intends to work for the fast realization of the project including the necessary fundraising while monitoring political and economic trends in Syria.

4. Realization of Co-benefit in the Host Country

(1) Evaluation of Pollution Prevention in the Host Country

The project site of GFC is one of the sources of atmospheric pollution in Homs City. Moreover, the purge gas targeted by the project contains ammonia which is harmful to human health, and the treatment of this is needed from the viewpoint of pollution prevention.

Although the concentration of ammonia in purge gas is less than 3%, the smell of ammonia pervades inside and outside the plant and it cannot be denied that this is causing an adverse impact on the surrounding environment.

The quantity of ammonia that will be circumvented from atmospheric discharge is calculated as follows:

- Quantity of purge gas = 7850Nm^3/h (dry gas) (7680 hours operation per year)
- Concentration of ammonia = 2.9%
- Weight of ammonia = 0.759 kg/Nm^3

Circumvented ammonia emissions= 7850 x 7680 x 2.9% x 0.759÷1000=1,327 t/year

From the above it can be seen that the atmospheric discharge of approximately 1,300 tons of ammonia will be circumvented every year.

From the viewpoint of environmental impact, the downwind ground concentration of ammonia in the case where discharge is not restricted is projected as follows using the expression for forecasting atmospheric dispersion.

The level of impact was projected through using the atmospheric dispersion model (plume model), which is commonly used for predicting the range of dispersion of air pollution and odor. Here, the following point source dispersion expression assuming the wind is blowing was adopted as the model expression.

○ Point source dispersion expression (when wind is blowing)

$$C = \frac{Q}{2\pi \cdot \sigma_y \cdot \sigma_z \cdot U} \exp\left\{-\frac{y^2}{2\sigma_y^{\ 2}}\right\} \cdot \left[\exp\left\{-\frac{(He - z)^2}{2\sigma_Z^{\ 2}}\right\} + \exp\left\{-\frac{(He^{\ 2} + z)}{2\sigma_Z^{\ 2}}\right\}\right]$$

Where,

C : Concentration at the forecasting point (m^3/m^3)

Y, z : Distance (m) in the perpendicular (y) and vertical (z) direction from the point source to the forecasting point

Q : Point source emission intensity ($m^3{}_N$/s)

U : Wind speed in the downwind direction (m/s) ※Downwind direction shall be the x direction.

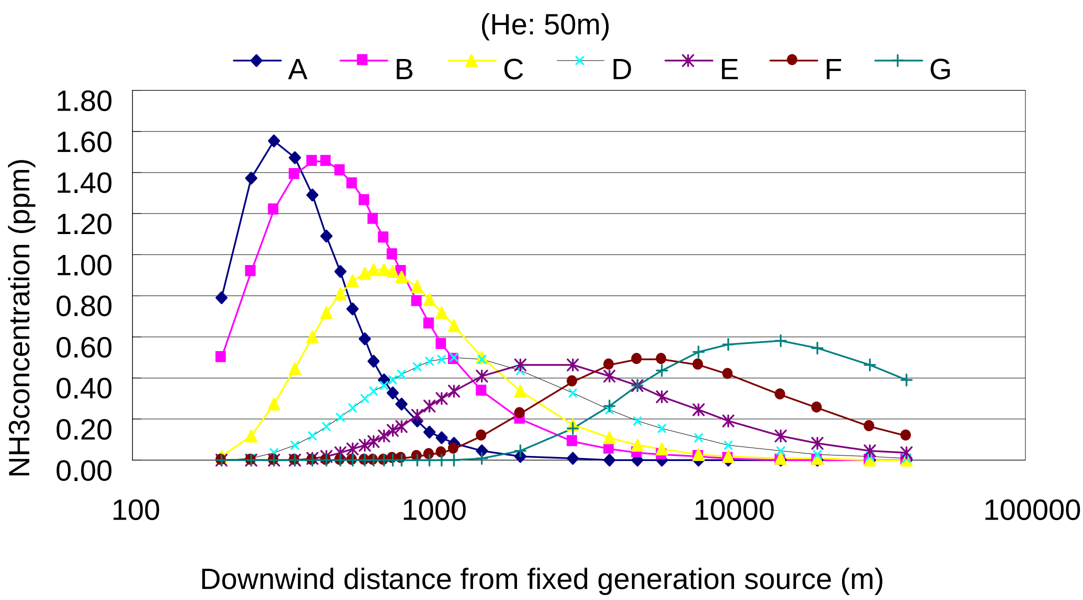
He : Effective stack height (m)

σ_y, σ_z : Perpendicular direction (y), vertical direction (z) and dispersion width (m)

Conditions for calculating atmospheric dispersion are set as follows.

NH3 concentration in purge gas		ppm	29,000
Quantity of purge gas emissions		m^3/sec	2.18
Emission intensity (Q_{NH3})		m^3/sec	0.0632
Atmospheric stability classes (A-G) and wind speed condition setting (U)	A	m/sec	2.0
	B	m/sec	2.0
	C	m/sec	3.0
	D	m/sec	4.0
	E (nighttime)	m/sec	3.0
	F (nighttime)	m/sec	2.0
	G (nighttime)	m/sec	1.0

The height of the purge gas smoke source is roughly 25 m, however, taking into account temperature and flow velocity of the exhaust gas, the effective stack height (He) is assumed to be 50 m. Moreover, concerning wind speed conditions, the wind speed was set slightly weaker than the average wind speed in Homs, while formation of a ground inversion layer was not taken into account.



Relationship between Ground NH3 Concentration and Distance According to Atmospheric Stability Class

The ground concentration of NH3 is roughly 1.5 ppm around 300~500 m from the purge gas outlet in atmospheric stability class (A) or (B), and it is 0.9 ppm at a distance of 700 m in atmospheric stability class (C).

Regulatory standards for odor at plant perimeters in Japan are prescribed by prefectural governors in the range of 1~5 ppm. Syria doesn't have such control values, however, in the case of the GFC, depending on the weather conditions, concentrations in excess of 1 ppm were detected on residential land in Cateena Village next to the plant. Assuming that a ground inversion layer is formed, there is a possibility that discernibly high concentrations will be generated, so the limitation of atmospheric emissions of ammonia in the project is significant.

Incidentally, concerning the recovered ammonia, this will be handed over to GFC for recycling separate from the project activities.

(2) Proposal of Co-benefit Indicators (when there are study results that can be proposed)

The biggest reason why developing countries (CDM host countries) have been so slow to implement pollution countermeasures is lack of budget.

The direct benefits of warming countermeasures are the economic value of credits, whereas the benefit in terms of pollution countermeasures is that measures can be taken without bearing any costs.

Accordingly, in the case where effects are evaluated using a set indicator in terms of both global warming prevention and pollution prevention, it is possible to use economic values such as the price of credits and cost of pollution countermeasures as indicators.

In the case of this project, it may be possible to propose the sum of 1) the economic value of carbon credits obtained from warming countermeasures and 2) initial investment cost in the event where only ammonia collection is implemented without the project, as the project assessment indicator taking co-benefit into account.