QUESTIONNAIRE FOR THE PETROCHEMICAL INDUSTRY (SECTOR RELATED QUESTIONS)

The completion of this questionnaire is voluntary. However, replying to the relevant questions as completely as possible will facilitate and speed up the assessment of the environmental, social and human rights impacts of the project for which the German export supplies or services offered for cover are intended. This – together with the questionnaire not related to a particular sector, the completion and submission of which should also be considered in order to speed up the assessment procedure – can replace the description of the environmental, social and human rights impacts in the memorandum.

The questionnaire provides guidance on what information may be important for this sector. It is based on the World Bank/IFC General Environmental Health and Safety (EHS) Guidelines, the EHS Guidelines for Petroleum Refining, the EHS Guidelines for Petroleum-based Polymers Manufacturing, the EHS Guidelines for Large Volume Petroleum-based Organic Chemicals Manufacturing, and the EHS Guidelines for Natural Gas Processing. Additional information on the applicable standards can be found at the AGA Portal.

This is a list of possible questions. Depending on the individual case only some of them, or perhaps also additional information, may become relevant in the course of the application procedure. Because of the specific features of each project further clarification may be required.

CONTENT

A. Refineries

A.1. Process and resources consumption

- Please give a technical description of the individual process steps. What catalysts and input materials (quality, composition, metal content, nitrogen content, sulfur content) are used?
- Does a production-related connection with other (planned) facilities exist?
- How is the planned plant supplied with energy and raw materials?
- How are the finished products removed?
- Please state the resources consumption after the project's completion in accordance with the table below:

Resource and Energy Consumption[1]			
	Unit	**Industry Benchmark**	**Project Value**
Land Use[1]	hectares	200 – 500	
Total Energy[1]	MJ per Metric Ton of processed crude oil	2100 – 2900	
Electric Power[1, 2]	KWh per Metric Ton of processed crude oil	25 - 48	
Fresh Make-up Water	m^3 per Metric Ton of processed crude oil	0.07 – 0.14	
Notes: [1] Based in part on EC BREF for Refineries [2] Greenfield facilities			
Source: WORLD BANK/IFC EHS Guidelines for PETROLEUM REFINING 2007, page 14			

A.2. Air emissions

- Please state the expected maximum values for air emissions after the project's completion for all process steps in accordance with the table below. Occasionally, not all pollutants listed in the table are emitted or others specific to the project have to be added. Please inform us if that is the case.

Air Emissions Levels for Petroleum Refining Facilities[1]			
	Unit	**Guideline Value**	**Project Value**
NO_X	mg/Nm^3	450	
SO_X	mg/Nm^3	150 for sulfur recovery units; 500 for other units	
Particulate Matter (PM)	mg/Nm^3	50	
Vanadium	mg/Nm^3	5	
Nickel	mg/Nm^3	1	
H_2S	mg/Nm^3	10	
Note: [1] Dry gas at 3 percent O_2.			
Source: WORLD BANK/IFC EHS Guidelines for PETROLEUM REFINING 2007, page 13			

- Please also state the (expected) emission values (in particular greenhouse gas emissions (CO_2eq), dust (PM), sulfur dioxide (SO_2) and nitrogen oxides (NO_x) in mg/Nm^3) for any steam and power generation. In the case of plants with a capacity of more than 50 $MW_{thermic}$ please use the questionnaire *Conventional Energy* as guideline.
- Please describe what measures are taken to avoid/reduce air emissions from the site.

- Please describe the method of venting and flaring gases used. Are any gases additionally released into the environment, except in cases of emergency venting? If gas flaring does not take place, reasons should be given.
- What limit values for ambient air quality are applicable in the buyer's country (please make a table available)? Please state the relevant expected air emission levels. Please comment on changes in the ambient air quality before and after the project implementation. If there are no national limit values, please use the table below.

WHO Ambient Air Quality Guidelines[1,2]					
	Averaging Period	**IFC Guideline Value [µg/m³]**	**Guideline Value Host country**	**Project Value (baseline status) [µg/m³]**	**Project Value (after implementation) [µg/m³]**
Sulfur dioxide (SO_2)	24-hour	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)			
	10 minute	500 (guideline)			
Nitrogen dioxide (NO_2)	1-year	40 (guideline)			
	1-hour	200 (guideline)			
Particulate Matter (PM_{10})	1-year	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)			
	24-hour	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)			
Particulate Matter ($PM_{2.5}$)	1-year	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline)			
	24-hour	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)			
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)			

Notes:
[1] World Health Organization (WHO). Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile.
[2] Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.

Source: WORLD BANK/IFC GENERAL EHS GUIDELINES 2007, page 4

- Please describe the on-site monitoring of air emissions as well as ambient air quality levels.

A.3. Fresh water and effluents

- How much (fresh) water is used on site? Is the water recirculated?
- Where and how is the water withdrawn?

- What wastewater streams are generated?
- How are effluents treated on site? Please also state whether effluents are discharged into a public sewage treatment system or into surface water bodies (river, lake, sea). If there are discharges, please provide information on the quantities of the wastewater streams (e.g. m^3/h or l/s).
- If wastewater is discharged directly into a surface water body, please state the maximum values of the pollution levels in accordance with the table below. Occasionally, not all pollutants listed in the table are emitted or others specific to the project have to be added. Please inform us if that is the case.

Effluent Levels for Petroleum Refining Facilities[1]			
Pollutants	**Units**	**Guideline Value**	**Project Value**
pH	S.U.	6-9	
BOD_5	mg/L	30	
COD	mg/L	150	
TSS	mg/L	30	
Oil and Grease	mg/L	10	
Chromium (total)	mg/L	0.5	
Chromium (hexavalent)	mg/L	0.05	
Copper	mg/L	0.5	
Iron	mg/L	3	
Cyanide (total)	mg/L	1	
Cyanide (free)	mg/L	0.1	
Lead	mg/L	0.1	
Nickel	mg/L	0.5	
Mercury	mg/L	0.02	
Vanadium	mg/L	1	
Phenol	mg/L	0.2	
Benzene	mg/L	0.05	
Benzo(a)pyrene	mg/L	0.05	
Sulfides	mg/L	1	
Total Nitrogen	mg/L	10[2]	
Total Phosphorus	mg/L	2	
Temperature increase	°C	<3[3]	

Notes:
[1] Assumes an integrated petroleum refining facility.
[2] The effluent concentration of nitrogen (total) may be up to 40 mg/l in processes that include hydrogenation.
[3] At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity.

Source: WELTBANK/IFC EHS Guidelines for PETROLEUM REFINING 2007, S. 13

- Please describe the measures planned to avoid/reduce/treat wastewater.
- Please describe the on-site monitoring of the effluent values.
- How and where are the effluents discharged? Please explicitly comment on a temperature rise at the point of discharge, describe possible effects of the discharge on the ecology of the water bodies and provide information on the condition and size of the water body (e.g. flow values, flow rate). Please give also details on protection measures.
- What national standards are applicable in the buyer's country for the discharge of sanitary sewage? How is sewage treated before it is discharged? Please state the expected maximum values of the pollution levels in the sewage. If there are no national limit values, please use the table below.

Indicative Values for Treated Sanitary Sewage Discharges[1]			
Pollutants	**Units**	**Guideline Value**	**Project Value**
pH	pH	6-9	
BOD	mg/L	30	
COD	mg/L	125	
Total nitrogen	mg/L	10	
Total phosphorus	mg/L	2	
Oil and grease	mg/L	10	
TSS	mg/L	50	
Total coliform bacteria	MPN[2]/100 ml	400[1]	

Notes:
[1] Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation.
[2] MPN = Most Probable Number

Source: WORLD BANK/IFC GENERAL EHS GUIDELINES 2007, page 30

A.4. Waste

- What relevant waste products are generated on site?
- Please state the amount of waste/emissions/waste water generated after the project's completion in accordance with the table below.

Emission and Waste Generation[1]			
Parameter	**Unit**	**Industry Benchmark**	**Project Value**
Waste water	Tons / million tons of processed crude oil	0.1 – 5	
Emissions			
▪ **Carbon dioxide**		25000 – 40000	
▪ **Nitrogen oxides**		90 – 450	
▪ **Particulate matter**		60 – 150	
▪ **Sulfur oxides**		60 – 300	
▪ **Volatile organic compounds**		120 – 300	
Solid Waste		20 – 100	
Note: [1] Based in part on EC BREF for Refineries			
Source: WORLD BANK/IFC EHS Guidelines for PETROLEUM REFINING 2007, page 14			

- What measures are taken of avoid, treat and dispose of the waste (solid/liquid) generated and where/how is it deposited?
- Please give also details on possible waste incineration processes (type and quantity of waste, incineration temperature, etc.).

A.5. Noise

- How far is the nearest residential area away?
- Are noise mitigation measures necessary or planned? If so, what measures?
- Please state the noise impact (existing background noise level and additional noise emissions of the project) on the nearest receptors (industrial estates and residential areas) in dB(A) for day and night after completion of the project in accordance with the table below.

Noise Level Guidelines[1]				
	One Hour LA_{eq} (dBA)			
Receptor	**Guideline Value Daytime (07:00-22:00)**	**Project Value Daytime (07:00-22:00)**	**Guideline Value Nighttime (22:00-07:00)**	**Project Value Nighttime (22:00-07:00)**
Residential; institutional; Educational[2]	55		45	
Industrial; commercial	70		70	
Notes: [1] Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, WHO, 1999. [2] For acceptable indoor noise levels for residential, institutional, and educational settings refer to WHO (1999).				
Source: WELTBANK/IFC GENERAL EHS GUIDELINES 2007, S. 53				

- Do the project's noise emissions lead to an increase of the background noise level at the nearest receptors by more than 3 dB(A)?

A.6. Occupational health and safety

- What safety measures and/or control systems are planned to prevent accidents?
- How are safety and health (in particular with regard to electromagnetic radiation, confined spaces, electrical hazards, fire and explosions, handling of toxic and hazardous substances, dust emissions, heat, noise) guaranteed at the workplace?
- What average and maximum noise exposure is to be expected at the workplaces? What safety measures are taken at workplaces where the noise exposure exceeds 85 dB(A)?

- How are subcontractors integrated into the health and safety measures on site?
- Please make accident statistics for the past two years available to us.

A.7. Health and safety of the population

- What measures are taken to minimize impacts and possible risks for adjacent communities in particular with regard to the storage and transport of chemicals, noise, odours, dust, traffic, sulfur and nitrogen emissions, fire and explosions?
- Please make information on infrastructure links (access roads, railway link, etc.), which may be necessary, available to us.

B. Petroleum-based polymers manufacturing

B.1. Process and resources consumption

- Please give a technical description of the individual process steps. What catalysts and input materials (quality, composition, metal content, nitrogen content, sulfur content) are used?
- Does a production-related connection with other (planned) facilities exist?
- What raw materials are required? Are these purchased or also produced at the site?
- How is the planned plant supplied with energy and raw materials?
- How are the finished products removed?
- Please state the resources consumption after the project's completion in accordance with the table below.

Resource, Energy Consumption, Emission and Waste (Teil 1)								
	Unit	**Industry Benchmark**						**Project Value**
Product		LDPE[20]	HDPE[14]	LLDPE	GPPS	HIPS	EPS	
Direct energy consumption[12]	kWh/t	720	570	580	300[2]	410[2]	500[2]	
Primary energy consumption[13]	kWh/t	2070	1180	810	-	-	-	
Water consumption[3]	m³/t	1.7	1.9	1.1	0.8	0.8	5.0	
Dust emission	g/t	17	56	11	2	2	30	
VOC emission[10]	g/t	700-1100	650	180-500[1]	85	85	450-700[4]	
COD emission	g/t	19	17	39	30	-	-	
Inert waste	kg/t	0.5	0.5	1.1	2.0	3.0	6.0	
Hazardous waste	kg/t	1.8	3.1	0.8	0.5	0.5	3.0	

Notes:
[1] According to type of comonomer (C4 or C8).
[2] European average
[3] Not including cooling water purge.
[4] 60% is pentane; not including storage.
[5] Average best 25%
[6] PVC dust
[7] After stripping, before WWT
[8] After final WWT
[9] Median value
[10] Inclusive of diffuse emissions.
[11] Direct energy is the total energy consumption as delivered.
[12] Primary energy is energy calculated back to fossil fuel. For the primary energy calculation the following efficiencies were used: electricity: 40 % and steam: 90 %.
[13] Good practice industry values.
[14] iPP values can be considered more or less equivalent.
[15] Before WWT
[16] Continuous process
[17] Solid waste containing > 1,000 ppm VCM
[18] Using catalytic oxidation (only point sources).
[19] TPA process plus continuous post-condensation.
[20] Based on tubular reactor.

Source: WORLD BANK/IFC EHS Guidelines for PETROLEUM-BASED POLYMERS MANUFACTURING 2007, page 15

Resource, Energy Consumption, Emission and Waste (Teil 2)								
	Unit	**Industry Benchmark**						**Project Value**
Product		S-PVC	E-PVC	PET[15, 19]	PA 6[15,17]	PA 66[15,16]	UPES	
Direct energy consumption	kWh/t	750-1100	2000-3000	850-1500	1.800-2000	1600-2100	<1000	
Primary energy consumption	kWh/t	1100-1600	2800-4300	-	-	-	-	
Water to waste	m³/t	4.0[9]	-	0.6-25	1-3	1.5-3.0	1-5	
Dust emission	g/t	40[6,9]	200[6,9]	-	-	-	5-30	
Monomer emission to air[5, 9,10]	g/t	18-43	245-813	-	6-10	-	-	
VOC emission[10]	g/t	-	-	5[18]	-	10-30	40-100	
Monomer emission to water[7,9]	g/t	3.5	10	-	-	-	-	
COD emission	g/t	480[8,9]	340[8,9]	2000-16000	4.300-5.700[16]	4.500-6.000[16]	-	
Inert waste	kg/t	-	-	0.8-18	3.0-3.5	3.0-3.5	-	
Hazardous waste[17]	kg/t	55[9]	74[9]	<0.45	0.2-0.5	0.2-0.5	<7	

Notes:
[1] According to type of comonomer (C4 or C8).
[2] European average
[3] Not including cooling water purge.
[4] 60% is pentane; not including storage.
[5] Average best 25%
[6] PVC dust
[7] After stripping, before WWT
[8] After final WWT
[9] Median value
[10] Inclusive of diffuse emissions.
[11] Direct energy is the total energy consumption as delivered.
[12] Primary energy is energy calculated back to fossil fuel. For the primary energy calculation the following efficiencies were used: electricity: 40 % and steam: 90 %.
[13] Good practice industry values.
[14] iPP values can be considered more or less equivalent.
[15] Before WWT
[16] Continuous process
[17] Solid waste containing > 1,000 ppm VCM
[18] Using catalytic oxidation (only point sources).
[19] TPA process plus continuous post-condensation.
[20] Based on tubular reactor.

Source: WORLD BANK/IFC EHS Guidelines for PETROLEUM-BASED POLYMERS MANUFACTURING 2007, page 15

B.2. Air emissions

- Please state the expected maximum values for air emissions after the project's completion for all process steps in accordance with the table below. Occasionally, not all pollutants listed in the table are emitted or others specific to the project have to be added. Please inform us if that is the case.

Air Emissions Guidelines			
	Unit	**Guideline Value**	**Project Value**
Particulate Matter (PM)	mg/Nm³	20	
Nitrogen Oxides	mg/Nm³	300	
Hydrogen Chloride	mg/Nm³	10	
Sulfur Oxides	mg/Nm³	500	
Vinyl Chloride (VCM)	g/t s-PVC	80	
	g/t e-PVC	500	
Acrylonitrile	mg/Nm³	5 (15 from dryers)	
Ammonia	mg/Nm³	15	
VOCs	mg/Nm³	20	
Heavy Metals (total)	mg/Nm³	1,5	
Hg	mg/Nm³	0,2	
Formaldehyde	mg/m³	0,15	
Dioxins / Furans	ng TEQ/Nm³	0,1	
Quelle: WELTBANK/IFC EHS Guidelines for PETROLEUM-BASED POLYMERS MANUFACTURING 2007, S. 13			

- Please also state the (expected) emission values (in particular greenhouse gas emissions (CO_2eq), dust (PM), sulfur dioxide (SO_2) and nitrogen oxides (NO_x) in mg/Nm³) for any steam and power generation. In the case of plants with a capacity of more than 50 $MW_{thermic}$ please use the questionnaire *Conventional Energy* as guideline.
- Please describe what measures are taken to avoid/reduce air emissions from the site.
- Please describe the method of venting and flaring gases used. Are any gases additionally released into the environment, except in cases of emergency venting? If gas flaring does not take place, reasons should be given.
- What limit values for ambient air quality are applicable in the buyer's country (please make a table available)? Please state the relevant expected air emission levels. Please comment on changes in the ambient air quality before and after the project implementation. If there are no national limit values, please use the table below.

WHO Ambient Air Quality Guidelines[1,2]					
	Averaging Period	**IFC Guideline Value [µg/m³]**	**Guideline Value Host country**	**Project Value (baseline status) [µg/m³]**	**Project Value (after imple-mentation) [µg/m³]**
Sulfur dioxide (SO_2)	24-hour	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)			
	10 minute	500 (guideline)			
Nitrogen dioxide (NO_2)	1-year	40 (guideline)			
	1-hour	200 (guideline)			
Particulate Matter (PM_{10})	1-year	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)			
	24-hour	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)			
Particulate Matter ($PM_{2.5}$)	1-year	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline)			
	24-hour	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)			
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)			
Notes: [1] World Health Organization (WHO). Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile. [2] Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.					
Source: WORLD BANK/IFC GENERAL EHS GUIDELINES 2007, page 4					

- Please describe the on-site monitoring of air emissions as well as ambient air quality levels.

B.3. Fresh water and effluents

- How much (fresh) water is used on site? Is the water recirculated?
- Where and how is the water withdrawn?

- What wastewater streams are generated?
- How are effluents treated on site? Please also state whether effluents are discharged into a public sewage treatment system or into surface water bodies (river, lake, sea). If there are discharges, please provide information on the quantities of the wastewater streams (e.g. m³/h or l/s).
- If wastewater is discharged directly into a surface water body, please state the maximum values of the pollution levels according to the table below. Occasionally, not all pollutants listed in the table are emitted or others specific to the project have to be added. Please inform us if that is the case.

Effluent Guidelines			
Pollutants	**Units**	**Guideline Value**	**Project Value**
pH	S.U.	6-9	
Temperature increase	°C	=3	
BOD_5	mg/L	25	
COD	mg/L	150	
Total Nitrogen	mg/L	10	
Total Phosphorus	mg/L	2	
Sulfide	mg/L	1	
Oil and Grease	mg/L	10	
TSS	mg/L	30	
Cadmium	mg/L	0.1	
Chromium (total)	mg/L	0.5	
Chromium (hexavalent)	mg/L	0.1	
Copper	mg/L	0.5	
Zinc	mg/L	2	
Lead	mg/L	0.5	
Nickel	mg/L	0.5	
Mercury	mg/L	0.01	
Phenols	mg/L	0.5	
Benzene	mg/L	0.05	
Vinyl Chloride	mg/L	0.05	
Adsorbable Organic Halogens	mg/L	0.3	
Toxicity	To be determined on a case specific basis		
Source: WORLD BANK/IFC EHS Guidelines for PETROLEUM-BASED POLYMERS MANUFACTURING 2007, page 14			

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- Please describe the measures planned to avoid/reduce/treat wastewater.
- Please describe the on-site monitoring of the effluent values.
- How and where are the effluents discharged? Please explicitly comment on a temperature rise at the point of discharge, describe possible effects of the discharge on the ecology of the water bodies and provide information on the condition and size of the water body (e.g. flow values, flow rate). Please give also details on protection measures.
- What national standards are applicable in the buyer's country for the discharge of sanitary sewage? How is sewage treated before it is discharged? Please state the expected maximum values of the pollution levels in the sewage. If there are no national limit values, please use the table below.

Indicative Values for Treated Sanitary Sewage Discharges[1]			
Pollutants	**Units**	**Guideline Value**	**Project Value**
pH	pH	6-9	
BOD	mg/L	30	
COD	mg/L	125	
Total nitrogen	mg/L	10	
Total phosphorus	mg/L	2	
Oil and grease	mg/L	10	
TSS	mg/L	50	
Total coliform bacteria	MPN[2]/100 ml	400[1]	
Notes: [1] Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation. [2] MPN = Most Probable Number			
Source: WORLD BANK/IFC GENERAL EHS GUIDELINES 2007, page 30			

B.4. Waste

- What relevant waste products are generated on site?
- What measures are taken of avoid, treat and dispose of the waste (solid/liquid) generated and where/how is it deposited? Please also address the issue of spent catalysts.

B.5. Noise

- How far is the nearest residential area away?
- Are noise mitigation measures necessary or planned? If so, what measures?
- Please state the noise impact (existing background noise level and additional noise emissions of the project) on the nearest receptors (industrial estates and residential areas) in dB(A) for day and night after completion of the project in accordance with the table below.

Noise Level Guidelines[1]				
	One Hour LA_{eq} (dBA)			
Receptor	**Guideline Value Daytime (07:00-22:00)**	**Project Value Daytime (07:00-22:00)**	**Guideline Value Nighttime (22:00-07:00)**	**Project Value Nighttime (22:00-07:00)**
Residential; institutional; Educational[2]	55		45	
Industrial; commercial	70		70	
Notes: [1] Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, WHO, 1999. [2] For acceptable indoor noise levels for residential, institutional, and educational settings refer to WHO (1999).				
Source: WORLD BANK/IFC GENERAL EHS GUIDELINES 2007, page 53				

- Do the project's noise emissions lead to an increase of the background noise level at the nearest receptors by more than 3 dB(A)?

B.6. Occupational health and safety

- What safety measures and/or control systems are planned to prevent accidents?
- How are safety and health (in particular with regard to electromagnetic radiation, confined spaces, electrical hazards, fire and explosions, handling of toxic and hazardous substances, dust emissions, heat, noise) guaranteed at the workplace?
- What average and maximum noise exposure is to be expected at the workplaces? What safety measures are taken at workplaces where the noise exposure exceeds 85 dB(A)?
- How are subcontractors integrated into the health and safety measures on site?
- Please make accident statistics for the past two years available to us.

B.7. Health and safety of the population

- What measures are taken to minimize impacts and possible risks for adjacent communities in particular with regard to the storage and transport of chemicals, noise, odours, dust, traffic, sulfur and nitrogen emissions, fire and explosions?
- Please make information on infrastructure links (access roads, railway link, etc.), which may be necessary, available to us.

C. Plants for organic chemicals manufacturing

C.1. Process and resources consumption

- Please state what kind of products will be produced at the site (e.g. lower olefins, aromatics, oxygenated compounds, nitrogen compounds, halogenated compounds).
- Please give a technical description of the individual process steps. What catalysts and input materials (quality, composition, metal content, nitrogen content, sulfur content) are used?
- Does a production-related connection with other (planned) facilities exist?
- How is the planned plant supplied with energy and raw materials?
- How are the finished products removed?
- What raw materials are required? Are these purchased or also produced at the site?
- Please state the resources consumption after the project's completion in accordance with the table below.

Resource and Energy Consumption[1]

Product	Parameter	Units	Industry Benchmark	Project Value
Lower Olefins	Energy consumption Ethane feedstock	GJ/t ethylene	15 – 25	
	Energy consumption Naphtha feedstock	GJ/t ethylene	25 – 40	
	Energy consumption Gas oil feedstock	GJ/t ethylene	40 – 50	
Aromatics	Steam	kg/t feedstock	0,5 – 1	
Formaldehyde Silver/Oxide process	Electricity	Kwh/t formaldehyde	100/200-225	
VCM	Power	MWh/t VCM	1,2 – 1,3	

Note:
[1] EIPPCB BREF (2003)

Source: WORLD BANK/IFC EHS Guidelines for LARGE VOLUME PETROLEUM-BASED ORGANIC CHEMICALS MANUFACTURING 2007, page 24

C.2. Air emissions

- Please state the expected maximum values for air emissions after the project's completion for all process steps in accordance with the table below. Occasionally, not all pollutants listed in the table are emitted or others specific to the project have to be added. Please inform us if that is the case.

Air Emissions Guidelines[1]			
Pollutant	**Unit**	**Guideline Value**	**Project Value**
Particulate Matter (PM)	mg/Nm³	20	
Nitrogen Oxides	mg/Nm³	300	
Hydrogen Chloride	mg/Nm³	10	
Sulfur Oxides	mg/Nm³	100	
Benzene	mg/Nm³	5	
1,2-Dichloroethane	mg/Nm³	5	
Vinyl Chloride (VCM)	mg/Nm³	5	
Acrylonitrile	mg/Nm³	0.5 (incineration) 2 (scrubbing)	
Ammonia	mg/Nm³	15	
VOCs	mg/Nm³	20	
Heavy Metals (total)	mg/Nm³	1.5	
Mercury and compounds	mg/Nm³	0.2	
Formaldehyde	mg/m³	0.15	
Ethylene	mg/m³	150	
Ethylene Oxide	mg/m³	2	
Hydrogen Cyanide	mg/m³	2	
Hydrogen Sulfide	mg/m³	5	
Nitrobenzene	mg/m³	5	
Organic Sulfide and Mercap-tans	mg/m³	2	
Phenols, Cresols and Xylols (as Phenol)	mg/m³	10	
Caprolactam	mg/m³	0.1	
Dioxins / Furans	ng TEQ/Nm³	0.1	
Note: [1] Dry, 273K (0°C), 101.3 kPa (1 atmosphere), 6% O_2 for solid fuels; 3 % O_2 for liquid and gaseous fuels.			
Source: WORLD BANK/IFC EHS Guidelines for LARGE VOLUME PETROLEUM-BASED ORGANIC CHEMICALS MANUFACTURING 2007, page 23			

- Please also state the (expected) emission values (in particular greenhouse gas emissions (CO_2eq), dust (PM), sulfur dioxide (SO_2) and nitrogen oxides (NO_x) in mg/Nm³) for any steam and power generation. In the case of plants with a capacity of more than 50 $MW_{thermic}$ please use the questionnaire *Conventional Energy* as guideline.
- Please describe what measures are taken to avoid/reduce air emissions from the site.
- Please describe the method of venting and flaring gases used. Are any gases additionally released into the environment, except in cases of emergency venting? If gas flaring does not take place, reasons should be given.
- What limit values for ambient air quality are applicable in the buyer's country (please make a table available)? Please state the relevant expected air emission levels. Please comment on changes in the ambient air quality before and after the project implementation. If there are no national limit values, please use the table below.

WHO Ambient Air Quality Guidelines[1,2]					
	Averaging Period	**IFC Guideline Value [µg/m³]**	**Guideline Value Host country**	**Project Value (baseline status) [µg/m³]**	**Project Value (after imple-mentation) [µg/m³]**
Sulfur dioxide (SO_2)	24-hour	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)			
	10 minute	500 (guideline)			
Nitrogen dioxide (NO_2)	1-year	40 (guideline)			
	1-hour	200 (guideline)			
Particulate Matter (PM_{10})	1-year	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)			
	24-hour	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)			
Particulate Matter ($PM_{2.5}$)	1-year	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline)			
	24-hour	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)			
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)			
Notes: [1] World Health Organization (WHO). Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile. [2] Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.					
Source: WORLD BANK/IFC GENERAL EHS GUIDELINES 2007, page 4					

- Please describe the on-site monitoring of air emissions as well as ambient air quality levels.

C.3. Fresh water and effluents

- How much (fresh) water is used on site? Is the water recirculated?
- Where and how is the water withdrawn?
- What wastewater streams are generated?

- How are effluents treated on site? Please also state whether effluents are discharged into a public sewage treatment system or into surface water bodies (river, lake, sea). If there are discharges, please provide information on the quantities of the wastewater streams (e.g. m³/h or l/s).
- If wastewater is discharged directly into a surface water body, please state the maximum values of the pollution levels according to the table below. Occasionally, not all pollutants listed in the table are emitted or others specific to the project have to be added. Please inform us if that is the case.

Effluents Guidelines			
Pollutants	**Units**	**Guideline Value**	**Project Value**
pH	S.U.	6-9	
Temperature increase	°C	=3	
BOD_5	mg/L	25	
COD	mg/L	150	
Total Nitrogen	mg/L	10	
Total Phosphorus	mg/L	2	
Sulfide	mg/L	1	
Oil and Grease	mg/L	10	
TSS	mg/L	30	
Cadmium	mg/L	0.1	
Chromium (total)	mg/L	0.5	
Chromium (hexavalent)	mg/L	0.1	
Copper	mg/L	0.5	
Zinc	mg/L	2	
Lead	mg/L	0.5	
Nickel	mg/L	0.5	
Mercury	mg/L	0.01	
Phenol	mg/L	0.5	
Benzene	mg/L	0.05	
Vinyl Chloride (VCM)	mg/L	0.05	
1,2 Dichloroethane (EDC)	mg/L	1	
Adsorbable Organic Halogens (AOX)	mg/L	1	
Toxicity	To be determined on a case specific basis		
Source: WORLD BANK/IFC EHS Guidelines for LARGE VOLUME PETROLEUM-BASED ORGANIC CHEMICALS MANUFACTURING 2007, page 23			

- Please describe the measures planned to avoid/reduce/treat wastewater.
- Please describe the on-site monitoring of the effluent values.
- How and where are the effluents discharged? Please explicitly comment on a temperature rise at the point of discharge, describe possible effects of the discharge on the ecology of the water bodies and provide information on the condition and size of the water body (e.g. flow values, flow rate). Please give also details on protection measures.

- What national standards are applicable in the buyer's country for the discharge of sanitary sewage? How is sewage treated before it is discharged? Please state the expected maximum values of the pollution levels in the sewage. If there are no national limit values, please use the table below.

Indicative Values for Treated Sanitary Sewage Discharges[1]			
Pollutants	**Units**	**Guideline Value**	**Project Value**
pH	pH	6-9	
BOD	mg/L	30	
COD	mg/L	125	
Total nitrogen	mg/L	10	
Total phosphorus	mg/L	2	
Oil and grease	mg/L	10	
TSS	mg/L	50	
Total coliform bacteria	MPN[2]/100 ml	400[1]	
Notes: [1] Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation. [2] MPN = Most Probable Number			
Source: WORLD BANK/IFC GENERAL EHS GUIDELINES 2007, page 30			

C.4. Waste

- What relevant waste products are generated on site?
- What measures are taken of avoid, treat and dispose of the waste (solid/liquid) generated and where/how is it deposited? Please also address the issue of spent catalysts.
- Please state the amount of emissions, waste water and waste generated after the project's completion in accordance with the table below.

Emissions, Effluents Waste/Co-Products Generation[1]				
Product	**Parameter**	**Units**	**Guideline Value**	**Project Value**
Lower Olefins	Alkenes	t/y	2500	
	CO, NO_X	t/y	200	
	SO_X	t/y	600	
	VOC	kg/t ethylene	0.6 – 10	
	Waste Water Flow	m^3/h	15	
	Total hydroc. losses	% feed/ kg/t ethylene	0.3 – 0.5 / 5 – 15	
Aromatics	NO_X	kg/t feedstock	0 – 0.123	
	SO_2	kg/t feedstock	0 – 0.146	
Acrylonitrile	Hydrogen cyanide	kg/t acrylonitrile	90 – 120	
	Acetonitrile	kg/t acrylonitrile	5 – 32	
	Ammonium sulfate	kg/t acrylonitrile	115 – 200	

Caprolactam Basf/Rashig proc.	Ammonium sulfate	t/t caprolactam	2.5 – 4.5	
TDI	COD/TOC	kg/t TDI	6 / 2	
	Nitrate, nitrite / sulfate	kg/t TDI	1510 / 24	
VCM	Liquid residues	kg/t VCM	25 – 40	
	Oxy catalyst	kg/t VCM	10 – 20	
	Iron salts	kg/t VCM	10 – 50	
	Coke	kg/t VCM	0.1 – 0.2	
Note: [1] EIPPCB BREF (2003)				
Source: WORLD BANK/IFC EHS Guidelines for LARGE VOLUME PETROLEUM-BASED ORGANIC CHEMICALS MANUFACTURING 2007, page 24				

C.5. Noise

- How far is the nearest residential area away?
- Are noise mitigation measures necessary or planned? If so, what measures?
- Please state the noise impact (existing background noise level and additional noise emissions of the project) on the nearest receptors (industrial estates and residential areas) in dB(A) for day and night after completion of the project in accordance with the table below.

Noise Level Guidelines[1]				
	One Hour LA_{eq} (dBA)			
Receptor	**Guideline Value Daytime (07:00-22:00)**	**Project Value Daytime (07:00-22:00)**	**Guideline Value Nighttime (22:00-07:00)**	**Project Value Nighttime (22:00-07:00)**
Residential; institutional; Educational[2]	55		45	
Industrial; commercial	70		70	
Notes: [1] Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, WHO, 1999. [2] For acceptable indoor noise levels for residential, institutional, and educational settings refer to WHO (1999).				
Source: WORLD BANK/IFC GENERAL EHS GUIDELINES 2007, page 53				

- Do the project's noise emissions lead to an increase of the background noise level at the nearest receptors by more than 3 dB(A)?

C.6. Occupational health and safety

- What safety measures and/or control systems are planned to prevent accidents?
- How are safety and health (in particular with regard to electromagnetic radiation, confined spaces, electrical hazards, fire and explosions, handling of toxic and hazardous substances, dust emissions, heat, noise) guaranteed at the workplace?
- What average and maximum noise exposure is to be expected at the workplaces? What safety measures are taken at workplaces where the noise exposure exceeds 85 dB(A)?

- How are subcontractors integrated into the health and safety measures on site?
- Please make accident statistics for the past two years available to us.

C.7. Health and safety of the population

- What measures are taken to minimize impacts and possible risks for adjacent communities in particular with regard to the storage and transport of chemicals, noise, odours, dust, traffic, sulfur and nitrogen emissions, fire and explosions?
- Please make information on infrastructure links (access roads, railway link, etc.), which may be necessary, available to us.

D. Natural gas processing

D.1. Process and resources consumption

- Please give a technical description of the individual process steps for the entire complex.
- Does a production-related connection with other (planned) facilities (e.g. gas extraction, pipelines, etc.) exist?

D.2. Air emissions

- Please state the expected maximum values for air emissions after the project's completion for all process steps in accordance with the table below. Occasionally, not all pollutants listed in the table are emitted or others specific to the project have to be added. Please inform us if that is the case.

Air Emissions Levels for Natural Gas Processing Facilities[1]			
Pollutant	**Unit**	**Guideline Value**	**Project Value**
NO_X	mg/Nm³	150[2] 50[3]	
SO_2	mg/Nm³	75	
Particulate Matter (PM10)	mg/Nm³	10	
VOC	mg/Nm³	150	
CO	mg/Nm³	100	
Notes: [1] Dry gas at 15% oxygen [2] The 150 mg/NM3 NO_x value is applicable to facilities with a total heat input capacity of up to 300 MWth. [3] The 50 mg/NM3 NO_x value is applicable to facilities with a total heat input capacity greater than 300 MWth.			
Source: WORLD BANK/IFC EHS Guidelines for NATURAL GAS PROCESSING 2007, page 10			

- Please also state the (expected) emission values (in particular greenhouse gas emissions (CO_2eq), dust (PM), sulfur dioxide (SO_2) and nitrogen oxides (NO_x) in mg/Nm³) for any steam and power generation. In the case of plants with a capacity of more than 50 $MW_{thermic}$ please use the questionnaire *Conventional Energy* as guideline.
- Please describe what measures are taken to avoid/reduce air emissions from the site.
- Please describe the method of venting and flaring gases used. Are any gases additionally released into the environment, except in cases of emergency venting? If gas flaring does not take place, reasons should be given.
- What limit values for ambient air quality are applicable in the buyer's country (please make a table available)? Please state the relevant expected air emission levels. Please comment on changes in the ambient air quality before and after the project implementation. If there are no national limit values, please use the table below.

WHO Ambient Air Quality Guidelines[1,2]					
	Averaging Period	**IFC Guideline Value [µg/m³]**	**Guideline Value Host country**	**Project Value (baseline status) [µg/m³]**	**Project Value (after implementation) [µg/m³]**
Sulfur dioxide (SO_2)	24-hour	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)			
	10 minute	500 (guideline)			
Nitrogen dioxide (NO_2)	1-year	40 (guideline)			
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Notes: [1] World Health Organization (WHO). Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile. [2] Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.					
Source: WORLD BANK/IFC GENERAL EHS GUIDELINES 2007, page 4					

- Please describe the on-site monitoring of air emissions as well as ambient air quality levels.

D.3. Fresh water and effluents

- How much (fresh) water is used on site? Is the water recirculated?
- Where and how is the water withdrawn?
- What wastewater streams are generated?
- How are effluents treated on site? Please also state whether effluents are discharged into a public sewage treatment system or into surface water bodies (river, lake, sea). If there are discharges, please provide information on the quantities of the wastewater streams (e.g. m³/h or l/s).
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Effluents Levels for Natural Gas Processing Facilities			
Pollutant	**Unit**	**Guideline Value**	**Project Value**
pH	S.U.	6 – 9	
BOD_5	mg/L	50	
COD	mg/L	150	
TSS	mg/L	50	
Oil and Grease	mg/L	10	
Cadmium	mg/L	0.1	
Total Residual Chlorine	mg/L	0.2	
Chromium (total)	mg/L	0.5	
Copper	mg/L	0.5	
Iron	mg/L	3	
Zinc	mg/L	1	
Cyanide (free)	mg/L	0.1	
Cyanide (total)	mg/L	1	
Lead	mg/L	0.1	
Nickel	mg/L	1.5	
Heavy metals total	mg/L	5	
Phenol	mg/L	0.5	
Nitrogen	mg/L	40	
Phosphorous	mg/L	3	
Source WORLD BANK/IFC EHS Guidelines for NATURAL GAS PROCESSING 2007, page 11			

- Please describe the measures planned to avoid/reduce/treat wastewater.
- Please describe the on-site monitoring of the effluent values.
- How and where are the effluents discharged? Please explicitly comment on a temperature rise at the point of discharge, describe possible effects of the discharge on the ecology of the water bodies and provide information on the condition and size of the water body (e.g. flow values, flow rate). Please give also details on protection measures.
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Total coliform bacteria	MPN[2]/100 ml	400[1]	
Notes: [1] Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation. [2] MPN = Most Probable Number			
Source: WORLD BANK/IFC GENERAL EHS GUIDELINES 2007, page 30			

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Noise Level Guidelines[1]				
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Notes: [1] Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, WHO, 1999. [2] For acceptable indoor noise levels for residential, institutional, and educational settings refer to WHO (1999).				
Source: WORLD BANK/IFC GENERAL EHS GUIDELINES 2007, page 53				

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D.6. Occupational health and safety

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- How are subcontractors integrated into the health and safety measures on site?
- Please make accident statistics for the past two years available to us.

D.7. Health and safety of the population

- What measures are taken to minimize impacts and possible risks for adjacent communities in particular with regard to the storage and transport of chemicals, noise, odours, dust, traffic, sulfur and nitrogen emissions, fire and explosions?
- Please make information on infrastructure links (access roads, railway link, etc.), which may be necessary, available to us.

E. Additional information

Additional information on the **Common Approaches**, our **environmental, social and human rights due diligence** and the **applicable standards** can be found at:

https://agaportal.de/en/main-navigation/schnellzugriff-aga-konsortium/verantwortung

The **World Bank/IFC EHS Guidelines** can be found on the website:

http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/ehsguidelines.