CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT (CDM-PDD)
Version 01 (in effect as of: 29 August 2002)

Introductory Note

1. This document contains the clean development mechanism project design document (CDM-PDD). It elaborates on the outline of information in Appendix B “Project Design Document” to the Modalities and Procedures (decision 17/CP.7 contained in document FCCC/CP/2001/13/Add.2).

2. The CDM-PDD can be obtained electronically through the UNFCCC CDM web site (http://unfccc.int/cdm), by e-mail (cdm-info@unfccc.int) or in printed from the UNFCCC secretariat (Fax: +49-228-8151999).

3. *Explanations* for project participants are in italicized font.

4. The Executive Board may revise the project design document (CDM-PDD), if necessary. Revisions shall not affect CDM project activities validated at and prior to the date at which a revised version of the CDM-PDD enters into effect. Versions of the CDM-PDD shall be consecutively numbered and dated.

5. In accordance with the CDM M&P, the working language of the Board is English. The CDM-PDD shall therefore be submitted to the Executive Board filled in English. The CDM-PDD format will be available on the UNFCCC CDM web site in all six official languages of the United Nations.

6. The Executive Board recommends to the COP (COP/MOP) to determine, in the context of its decision on modalities and procedures for the inclusion of afforestation and reforestation activities in the CDM (see also paragraph 8-11 of decision 17/CP.7), whether the CDM-PDD shall be applicable to this type of activities or whether modifications are required.

7. A glossary of terms may be found on the UNFCCC CDM web site or from the UNFCCC secretariat by e-mail (cdm-info@unfccc.int) or in print (Fax: +49-228-815 1999).

CONTENTS

Annexes

A. General description of project activity

A.1 Title of the project activity:

Construction of new methanol production plant (called: M 5000) in the Republic of Trinidad and Tobago

A.2. Description of the project activity:

(Please include in the description
- the purpose of the project activity
- the view of the project participants of the contribution of the project activity to sustainable development (max. one page).)

During ammonia production, CO_2 is a joint product that has to be removed from the product stream prior to the final synthesis step as the catalysts would be poisoned otherwise. The CO_2 would normally be vented to the atmosphere. By introducing the additional carbon dioxide into the M 5000 (steam reforming based methanol production plant) the carbon intensity of methanol production can be improved, what results in a reduction of CO_2 emissions.
Furthermore, hydrogen rich purge gases from two existing nearby methanol plants that are currently used as a fuel, will be used as feed for the methanol production at the M5000. Even though the hydrogen taken has to be replaced by natural gas (the heating demand has to be satisfied) additional net CO_2 reductions are realised.
Through the project foreign exchange and technology are provided and fits well in the general Trinidadian strategy to diversify its economy and to make optimal use of its abundant natural resources. During construction about 1000 employees of various trades will be employed and about 150 post (most for locals) will be offered during operation.

A.3. Project participants:

(Please list Party(ies) and private and/or public entities involved in the project activity and provide contact information in Annex 1.)

Parties:
Republic of Trinidad and Tobago
Federal Republic of Germany[1]

Private entities:
Ferrostaal AG (Germany)
Methanol Holdings (Trinidad) Ltd.

(Please indicate at least one of the above as the contact for the CDM project activity.)

Ferrostaal AG (Germany)

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

---

[1] Project approval is currently under consideration; no formal approval has been conferred yet.

A.4.1.1 Host country Party(ies):
Trinidad and Tobago

A.4.1.2 Region/State/Province etc.:
/

A.4.1.3 City/Town/Community etc:
Point Lisas

A.4.1.4 Detail on physical location, including information allowing the unique identification of this project activity *(max one page)*:

As it is a large project, the information given in Annex I seems to be sufficient to identify the project.

A.4.2. Category(ies) of project activity

(Using the list of categories of project activities and of registered CDM project activities by category available on the UNFCCC CDM web site, please specify the category(ies) of project activities into which this project activity falls. If no suitable category(ies) of project activities can be identified, please suggest a new category(ies) descriptor and its definition, being guided by relevant information on the UNFCCC CDM web site.)

CO_2 Abatement

A.4.3. Technology to be employed by the project activity:

(This section should include a description on how environmentally safe and sound technology and know-how to be used is transferred to the host Party, if any.)

The project idea is not really to implement a new technology but rather a new process design. Nevertheless, all technical devices used represent the latest development and are fully mastered. They have been used in several plants constructed throughout the world in the recent years.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

(Please explain briefly how anthropogenic greenhouse gas (GHG) emission reductions are to be achieved (detail to be provided in section B.) and provide the total estimate of anticipated reductions in tonnes of CO_2 equivalent as determined in section E. below.)

During ammonia production CO_2 is a joint product that has to be removed from the product stream prior to the final synthesis step as the catalysts would be poisoned otherwise. The CO_2 would normally be vented to the atmosphere. By introducing the additional carbon dioxide into the M 5000 (steam reforming based methanol production plant) the carbon intensity of methanol production can be improved, what results in a reduction of CO_2 emissions.
Furthermore, hydrogen rich purge gases from two existing nearby methanol plants that are currently used as a fuel will be used as feed for the methanol production at the M5000. Even though the hydrogen taken has to be replaced by natural gas (the heating demand has to be satisfied) additional net CO_2 reductions are realised.

About 228,690 CO_2 /y will be reduced by the project.

A.4.5. Public funding of the project activity:

(In case public funding from Parties included in Annex I is involved, please provide in Annex 2 information on sources of public funding for the project activity, including an affirmation that such funding does not result in a diversion of official development assistance and is separate from and is not counted towards the financial obligations of those Parties.)

There is no public funding.

B. Baseline methodology

B.1 Title and reference of the methodology applied to the project activity:

(Please refer to the UNFCCC CDM web site for the title and reference list as well as the details of approved methodologies. If a new baseline methodology is proposed, please fill out Annex 3. Please note that the table "Baseline data" contained in Annex 5 is to be prepared parallel to completing the remainder of this section.)

New Baseline → see Annex

B.2. Justification of the choice of the methodology and why it is applicable to the project activity

The Methodology has been developed for projects like this.

B.3. Description of how the methodology is applied in the context of the project activity:

Tab. 2 provides an overview on the methanol plants with a capacity greater than 1000 tons per day (tpd) that started operation during the last 60 month. CO_2 addition has not been used in new plants during the last 5 years.[2] as it will be done in M5000. As mentioned in the methodology, it is of crucial importance to specify the gas input for the calculation of the overall emission balance.

The CO_2 Source: Ammonia Production

Ammonia is produced according to the reaction

$$3H_2 + N_2 \leftrightarrow 2NH_3$$

in ammonia converters by means of catalysts.

If natural gas is available in sufficient quantities, as it is the case in Trinidad & Tobago, the process is based on steam reforming and synthesis gas production similar to the methanol process.

In a first step natural gas reacts with water (steam) in a catalyst filled reformer forming carbon monoxide and hydrogen. In the subsequent water gas shift reaction the CO reacts with H_2O to CO_2 and additional hydrogen.

After the shift conversion carbon dioxide and residual carbon monoxide have to be removed since oxygen containing substances are poison for the ammonia synthesis catalyst.

This is usually done in two steps: After a bulk removal that leads to CO_2 concentrations of 0.005 –0.2 vol. %, the final purification leads to very low ppm levels. Even though there is a large variety of possible processes as for example cryogenic or membrane separation, the standard method for CO_2 removal (bulk) in ammonia production is to scrub the synthesis gas under pressure with a solvent capable of dissolving sufficient quantities of CO_2 at a sufficient rate. The solvent is then flashed to release the carbon dioxide and treated according to its characteristics to be recycled to the absorption column. The high concentrated and pure CO_2 is generally released to the atmosphere as a waste product or is used as a feed stock in other processes.

The purified gas stream that consists of hydrogen finally reacts with nitrogen in the ammonia converter.

[2] Even though it has been used occasionally before so that it is proven and mastered technology.

It is important to note, that the CO_2 has to be removed anyway and that thus no energy penalty has to be attributed to the gas when used in other processes.

Purge Gas Introduction

In the vicinity of the M5000 plant there are some older plants (named: CMC and TTMC). As mentioned in the proposed new methodology, the purge gases of these plants have a high share of hydrogen that is currently burned as fuel only. It is, however, possible to use this gas as feed within the M5000. It goes without saying that the missing gas has to be substituted in order to still meet the heat demand at the CMC and TTMC. This is done by additional natural gas what has to be considered in the final carbon balance (see Tab. 1).

Quantification of specific emissions

As it was not possible to get the concrete plant specific figures from the competitors, a conservative figure was used. Tab. 1. shows how specific emissions have been determined for a high performance conventional steam reforming plant (if constructed today) and for the M5000 project.

Table 1: Calculation of specific emissions for methanol production by steam reforming[3]

	High Performance Convent. Steam Reforming			Trinidad M5000		
	Nm3/h	Mol%	kmol/h C	Nm3/h	mol%	kmol/h C
C in feed	195643	95,39	8326,2	141568	100,21	6329,3
C in Ref fuel	2972	95,39	126,5	30956	100,21	1384,0
C in Boiler fuel	3364	95,39	143,2	5389	100,21	240,9
C in CO2	0			41242	94,09	1731,3
C in purge gas	0			32089	47,84	684,9
Total in			**8595,9**			**10370,4**
Cin flue gas	994132	4,42	1960,4	845766	8,19	3090,4
C exit boiler			143,2			240,9
C in MeOH	145833	99,82	6494,6	157818	99,99	7040,3
Total out			**8598,2**			**10371,7**
C out - C in			2,3			1,3
Error			0,03%			0,01%
CO2 te			92,6			146,6
MeOH te			208,1			225,6
CO2 te/te			**0,445**			**0,650**

NCV of natural gas, kcal/mol	191,622		
NCV of purge gas, kcal/mol	99,855		
A) 1 kmol of purge gas replaced by X kmol NG	0,521		
B) NG used to replace purge gas in CMC et al	16722	100,21	747,6
Carbon in purge gas no longer in CMC carbon balance			684,9
Nett extra C added to atmosphere from CMC et al (A-B)			62,7

Taking credit for CO2 import and penalty for NG burned in CMC et al:	
CO2 te	73,2
MeOH te	225,6
CO2 te/te	**0,324**

It is important to note that the Trinidad M5000 project treats several liquid effluent steams within the M5000 project even though this increases the overall energy demand within the project boundary. On another project it may be convenient for the liquid effluent to be sent to an external treatment plant. As the energy cost associated with the treatment must still be paid for, there would be a dollar cost in disposing of the effluent, but the energy cost (and CO2 emissions) would be excluded from an analysis

[3] Data provided by Davy Process Technology (UK) who provided the core technology. Software used: ProVision and an inhouse carbon tool.

that considers only the gas and power consumption of the methanol plant and not the associated operating costs. Thus, it would be reasonable to use the figure of 315 for the M5000 as well. Consequently, taking 324 (kg CO_2 / t MeOH) represents a conservative figure.

Tab. 2: Overview on methanol plants with a capacity > 1000 tpd that started operation during the last 60 month

A	B	c	d	e	f	g	h	i	j	k
Country	**Company**	**Location**	**1997**	**Production (,000 t/d 2002)**	**Production cumulative (,000 t/d 2002)**	**CO2 addition**	**specific emission (t/t)**	**Weighted emission ("e*h")**	**Weighted emission cumulative**	**Weighted specific emission ("i/f")**
Chile	Methanex	Pta. Arenas, TF	-	2786	2786	no	0.445	1240	1240	0.445
Other Africa	AMPCO	Bioko Is.	-	2429	5214	no	0.445	1081	2320	0.445
Saudi Arabia	Ar Razi	Al Jubail	-	2429	7643	no	0.445	1081	3401	0.445
Qatar	QAFAC	Mesaieed	-	2357	10000	no	0.445	1049	4450	0.445
Russia	Azot Togliatti	Togliatti	-	1286	11286	no	0.445	572	5022	0.445
Argentina	Repsol YPF	Neuquen	-	1143	12429	no	0.445	509	5531	0.445

Referring to point a) in Annex 3 it seems reasonable to assume that the plants constructed during the last 5 years (Tab. 2) belong to the top 20% of all existing steam reforming plants in the world as technology has improved during the recent years and as an increasing competition on the world market requires efficient use of feed and fuel used during production.[4] Even if the more restrictive approach is be chosen where only the plants presented in Table 2 form the basis for the calculation of the average top 20 %, the outcome does not change since a uniform, conservative figure (i.e. the best emission factor is considered for all plants) is used.
This is also the reason why the weighted average emissions (approach c3 in Annex 3) are the same for every quantity of output.

Consequently, the average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 per cent of their category amount to 0.445 t CO_2 / t MeOH.

[4] It is not possible to provide emission data for all these plants. A study showing general information can be provided.

B.4. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity *(i.e. explanation of how and why this project is additional and therefore not the baseline scenario)*

The project uses surplus carbon dioxide and high-quality (in terms of composition for use as feed during methanol production) purge gases to improve carbon intensity of methanol production and thus avoids emissions that would have been released if a conventional steam reforming plant had been built.

B.5. Description of how the definition of the project boundary related to the baseline methodology is applied to the project activity*:*

Fig. 1 shows the project boundary chosen for the M5000. It encompasses the core process of this plant, the CO_2 input from the ammonia plant as well as the purge gas stream from to existing adjacent methanol plant and the natural gas input which is used to replace the purge gas taken away.

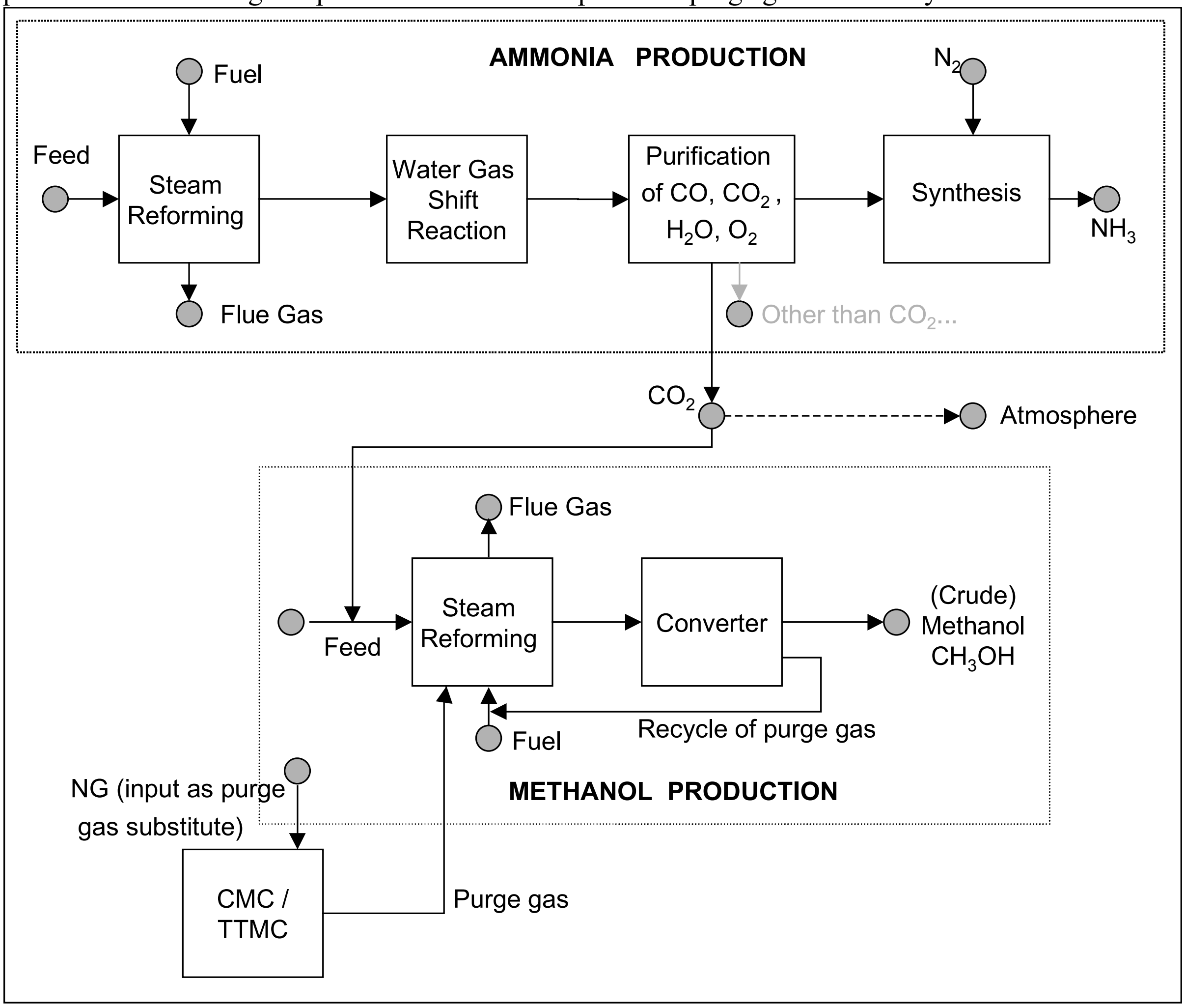


Fig. 1: Project boundary for the M5000 project.

As has already been mentioned in section B 3, effluent treatment was incorporated within the project boundary resulting in conservative approach.

B.6. Details of baseline development

B.6.1 Date of completing the final draft of this baseline section *(DD/MM/YYYY)*:
25/03/2003

B.6.2 Name of person/entity determining the baseline:
Programme "International Climate Policy", Hamburg Institute of International Economics, Neuer Jungerfernstieg 21, 20347 Hamburg (Germany) – no project participant.

(Please provide contact information and indicate if the person/entity is also a project participant listed in Annex 1.)

C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

(For a definition by the Executive Board of the term "starting date", please refer to UNFCCC CDM web site. Any such guidance shall be incorporated in subsequent versions of the CDM-PDD. Pending guidance, please indicate how the" starting date" has been defined and applied in the context of this project activity.)

The project execution is intended to start late 2002/early 2003 with the plant going on-stream approx. 30 months later, i.e. fall 2005 (to be specified.)

C.1.2. Expected operational lifetime of the project activity: *(in years and months, e.g. two years and four months would be shown as: 2y-4m)*

>> 15 years

C.2 Choice of the crediting period and related information: *(Please underline the appropriate option (C.2.1 or C.2.2.) and fill accordingly)*

(Note that the crediting period may only start after the date of registration of the proposed activity as a CDM project activity. In exceptional cases, the starting date of the crediting period can be prior to the date of registration of the project activity as provided for in paras. 12 and 13 of decision 17/CP.7 and through any guidance by the Executive Board, available on the UNFCCC CDM web site)

C.2.1. Renewable crediting period *(at most seven (7) years per period)*

C.2.1.1. Starting date of the first crediting period *(DD/MM/YYYY)*:

C.2.1.2. Length of the first crediting period *(in years and months, e.g. two years and four months would be shown as: 2y-4m)*:

C.2.2. Fixed crediting period *(at most ten (10) years)*:

C.2.2.1. Starting date *(DD/MM/YYYY)*:
~ 30 month after start of execution.

C.2.2.2. Length (max 10 years): *(in years and months, e.g. two years and four months would be shown as: 2y-4m)*

10 years

D. Monitoring methodology and plan

(The monitoring plan needs to provide detailed information related to the collection and archiving of all relevant data needed to
- estimate or measure emissions occurring within the project boundary;
- determine the baseline; and;
- identify increased emissions outside the project boundary.
The monitoring plan should reflect good monitoring practice appropriate to the type of project activity. Project participants shall implement the registered monitoring plan and provide data, in accordance with the plan, through their monitoring report.

Operational entities will verify that the monitoring methodology and plan have been implemented correctly and check the information in accordance with the provisions on verification. This section shall provide a detailed description of the monitoring plan, including an identification of the data and its quality with regard to accuracy, comparability, completeness and validity, taking into consideration any guidance contained in the methodology.

Please note that data monitored and required for verification and issuance are to be kept for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.)

D.1. Name and reference of approved methodology applied to the project activity:

(Please refer to the UNFCCC CDM web site for the name and reference as well as details of approved methodologies. If a new methodology is proposed, please fill out Annex 4.)

(If a national or international monitoring standard has to be applied to monitor certain aspects of the project activity, please identify this standard and provide a reference to the source where a detailed description of the standard can be found.)

New methodology (see Annex)

D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

Methodology has been developed for this kind of projects.

D.3. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

(Please add rows to the table below, as needed)

ID number *(Please use numbers to ease cross-referencing to table 5)*	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data kept?	Comment
1a	*Volume flow*	*CO_2 feed*	*m^3/h*	*m*	*Continously*		*Electronically*	*	
1b	*Concentration*	*CO_2 feed*	*kg/m^3*	*m*	*Weekly*		*Paper*	*	*Manual sampling*
2	*Mass flow*	*CO_2 in flue gas*	*kg/h*	*c*	*Weekly*		*Electronically*	*	*Calculating CO_2 in the flue gas provides figures at least as accurate as measuring: <u>all other</u> relevant streams are generally easier to measure and need to be measured very accurately for optimal operation control and/or for commercial reasons.*
3a	*Volume flow*	*Methanol in productstream*	*M^3/h*	*m*	*Continously*		*Electronically*	*	
3b	*Concentration*	*Methanol in productstream*	*t/m^3*	*m*	*Weekly*		*Paper*	*	*Manual sampling*
4a	*Volumeflow*	*Natural gas (fuel)*	*M3/h*	*M*	*Continously*		*Electronically*	*	
4b	*Conce*	*Natural*	*Mol/m*	*m*	*weekly*		*Paper*	*	*Manual sampling*

	ntration	*gas (fuel))*	*3*						
5a	*Volume Flow*	*Purge Gas*	*M3/h*	*m*	*Continously*		*Electronically*	*	
5b	*Concentration*	*H_2 and CH_4 in purge gas*	*Mol/m3*	*m*	*Weekly*		*Paper*	*	*Manuel sampling*
6a	*Volumeflow*	*Natural gas (feed)*	*M3/h*	*M*	*Continously*		*Electronically*	*	
6b	*Concentration*	*Natural gas (feed))*	*Mol/m3*	*m*	*weekly*		*Paper*	*	*Manual sampling*

** = for two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.*

D.4. Potential sources of emissions which are significant and reasonably attributable to the project activity, but which are not included in the project boundary, and identification if and how data will be collected and archived on these emission sources.

(Please add rows to the table below, as needed.)

All emissions that are significant and reasonably attributable to project activity have been included in the project boundaries.

D.5. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHG within the project boundary and identification if and how such data will be collected and archived.

(Depending on the methodology used to determine the baseline this table may need to be filled. Please add rows to the table below, as needed.)

ID number *(Please use numbers to ease cross-referencing to table D.6)*	Data type	Data variable	Data unit	Will data be collected on this item? (If no, explain).	How is data archived? (electronic/paper)	For how long is data archived to be kept?	Comment
3a	*Volume flow*	*Methanol in productstream*	*M^3/h*	*y*	*Electronically*	*	

3b	*Concentration*	*Methanol in productstream*	*t/m³*	*y*	*Paper*	*	*Manual sampling*

** = two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.*

D.6. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored. *(data items in tables contained in section D.3., D.4. and D.5 above, as applicable)*

Data *(Indicate table and ID number e.g. 3.-1; 3.-2.)*	Uncertainty level of data (High/Medium/Low)	Are QA/QC procedures planned for these data?	Outline explanation why QA/QC procedures are or are not being planned.
1a, 3a, 4a, 6a, 6a,	*low*	*All measurement instruments are calibrated according to international standards*	*High quality data is in the operator's interest as it is needed to operate the plant efficiently and thus at least costs.*
1b. 3b. 4b. 5b. 6b.	*Low*	*Staff for sample taking will be trained appropriately, manuals are to be provided*	*The laboratory is certified according to ISO 9001*

D.7 Name of person/entity determining the monitoring methodology:

Programme "International Climate Policy", Hamburg Institute of International Economics, Neuer Jungerfernstieg 21, 20347 Hamburg (Germany) – no project participant.

(Please provide contact information and indicate if the person/entity is also a project participant listed in Annex 1 of this document.)

E. Calculation of GHG emissions by sources

E.1 Description of formulae used to estimate anthropogenic emissions by sources of greenhouse gases of the project activity within the project boundary: *(for each gas, source, formulae/algorithm, emissions in units of CO_2 equivalent)*

Expected emissions are determined as follows:

$$E^P = e^p * x^p$$

where E^P total CO_2 emissions of the project (t CO_2); e^p = specific CO_2 emissions of the M5000 (t CO_2 / t CH_3OH); x^p = total methanol production by the M5000 with CO_2 addition (t methanol)

E.2 Description of formulae used to estimate leakage, defined as: the net change of anthropogenic emissions by sources of greenhouse gases which occurs outside the project boundary, and that is measurable and attributable to the project activity: *(for each gas, source, formulae/algorithm, emissions in units of CO_2 equivalent)*

-

E.3 The sum of E.1 and E.2 representing the project activity emissions:

$$E^P = e^p * x^p$$

E.4 Description of formulae used to estimate the anthropogenic emissions by sources of greenhouse gases of the baseline: *(for each gas, source, formulae/algorithm, emissions in units of CO_2 equivalent)*

The baseline can then be calculated as follow:

$$E^B = e^s * x^p$$

where E^B total CO_2 emissions of the reference scenario (t CO_2); e^s = average specific CO_2 emissions from steam reforming (t CO_2 / t CH_3OH); x^p = total methanol production by the M 5000 with CO_2 addition (t methanol)

E.5 Difference between E.4 and E.3 representing the emission reductions of the project activity:

$$E^R = E^B - E^P$$

$$E^R = (e^B - e^P) * x^P$$

E.6 Table providing values obtained when applying formulae above:[5]

E^P= *0.324 t CO2 / t MeOH * 1,890,000 t MeOH / y = 612,360 t CO_2 /y*

E^B = *0.445 t CO_2 / t MeOH * 1,890,000 t MeOH/y = 841,050 t CO_2 / y*

E^R= *841,050 t CO_2 / y - 612,360 t CO_2 /y* = 228,690 *CO_2 /y*

F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts *(Please attach the documentation to the CDM-PDD.)*

An environmental impact assessment according the Environmental Management Act in Trinidad and Tobago has been conducted. (see attachment).

F.2. If impacts are considered significant by the project participants or the host Party: *please provide conclusions and all references to support documentation of an environmental impact assessment that has been undertaken in accordance with the procedures as required by the host Party.*

The authorisation to carry out the project has been conferred on December 06, 2001 (see attachment: Certificate of the environmental Clearance).

G. Stakeholders comments

G.1. Brief description of the process on how comments by local stakeholders have been invited and compiled:

A public consultation was held at Point Lisas on July 5, 2001.

G.2. Summary of the comments received:

See attached protocol of the public consultation

G.3. Report on how due account was taken of any comments received:

See attached protocol of the public consultation

---

[5] Daily production: 5400 t; Number of days in operation: 350

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

(Please copy and paste table as needed)

Organization:	Ferrostaal AG
Street/P.O.Box:	Hohenzollernstr. 24
Building:	
City:	Essen
State/Region:	
Postfix/ZIP:	45128
Country:	Germany
Telephone:	+49 201 818 2210
FAX:	
E-Mail:	Wolfgang.Marschewski@ferrostaal.com
URL:	www.ferrostaal.de
Represented by:	
Title:	Dipl.-Ing
Salutation:	
Last Name:	Marschewski
Middle Name:	
First Name:	Wolfgang
Department:	
Mobile:	
Direct FAX:	+49 201 818 3931
Direct tel:	+49 201 818 2210
Personal E-Mail:	Wolfgang.Marschewski@ferrostaal.com

(Please copy and paste table as needed)

Organization:	Methanol Holdings Ltd.
Street/P.O.Box:	Atlantic Avenue, Point Lisas Industrial estate
Building:	
City:	Point Lisas
State/Region:	Couva
Postfix/ZIP:	
Country:	Republic of Trinidad and Tobago
Telephone:	
FAX:	
E-Mail:	
URL:	
Represented by:	
Title:	
Salutation:	Chief Executive Officer
Last Name:	Motilal
Middle Name:	
First Name:	Rampersad
Department:	
Mobile:	

Direct FAX:	(868) 679-2404
Direct tel:	(868) 679-2404
Personal E-Mail:	motilalr@ttmethanol.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding.

Annex 3

NEW BASELINE METHODOLOGY

(The baseline for a CDM project activity is the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases that would occur in the absence of the proposed project activity. A baseline shall cover emissions from all gases, sectors and source categories listed in Annex A of the Kyoto Protocol within the project boundary. The general characteristics of a baseline are contained in para. 45 of the CDM M&P.

For guidance on aspects to be covered in the description of a new methodology, please refer to the UNFCCC CDM web site.

Please note that the table "Baseline data" contained in Annex 5 is to be prepared parallel to completing the remainder of this section.)

1. Title of the proposed methodology:

Improvement of carbon intensity of new methanol production plants based on steam reforming.

2. Description of the methodology:

2.1. General approach *(Please check the appropriate option(s))*

☐ Existing actual or historical emissions, as applicable;

As a new project can be considered as additional capacity, this option seems not applicable. (If it is demonstrably replacing an existing plant, emissions of this particular plant form the baseline. This baseline is only valid for the remaining economic lifetime of the existing plant. After this lifetime is over, the baseline has to be calculated using one of the approaches under (b) or (c).)

☐ Emissions from a technology that represents an economically attractive course of action, taking into account barriers to investment;

Generally applicable, but difficult to gather data required.

When analysing the economics of a methanol plant several aspects have to be taken into account, as for example:

- Energy costs
- Costs of auxiliary material (e.g. water)
- Shipping
- Capital costs (project specific)
- Availability of / need for side streams.

All these aspects vary significantly from site to site so that it is very difficult, if not impossible to judge one process the most economically attractive one[6].

X The average emissions of similar project activities undertaken in the previous five years, in similar social, economic, environmental and technological circumstances, and whose performance is among the top 20 per cent of their category.

Applicable

Specifications:

a) For the determination of the top 20 per cent all existing plants are to be considered. That is to say, plants constructed during the last five years are only considered for the calculation of average emissions as long as their performance is among the top 20 per cent of all existing plants.

b) The term "last five years" is calculated as follows: Plants that started operation during the last 60 month prior to the submission of the PDD to the validator.

c) There are several options for the basis for the determination of the top 20 percent. (Approach 3 shall be applied.)

1) Simple counting of the number of plants.
Example: 10 plants started operation during the last 60 month →The two plants with best performance form the basis.

2) Consideration of the output during the last 60 month.
Example:

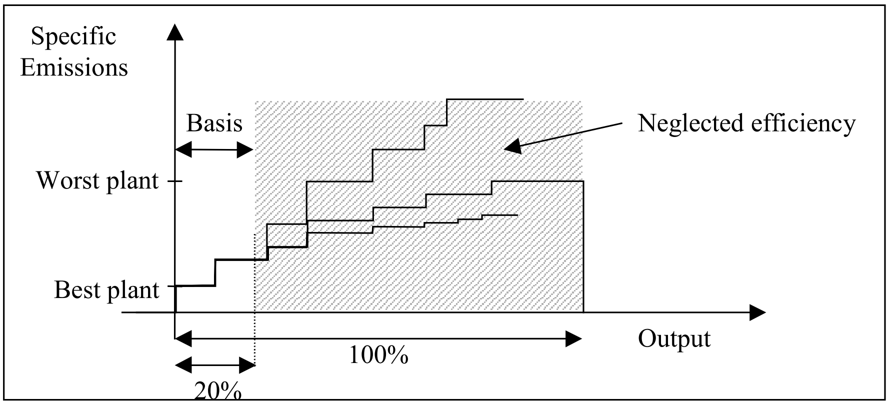


Fig. 2: Output during the last 60 month forming the basis for the determination of top 20 %

Following this approach, the overall emission intensity (i.e. what actually happened) would, however, not be taken into account.

3) Consideration of the weighted emissions from output during the last 60 month applying equation XXX

[6] However, low cost supply of CO_2 can reduce costs of the a new plant compared to a no CO_2 addition steam reforming plant. This is why costs of CO_2 from different sources might be analysed in order to get at least of an idea on the financial attractiveness of such a project.

$$e^{20} = e^* + \left(\frac{\sum_i (c_i * e_i)}{\sum_i c_i} - e^* \right) * 0{,}2$$

where: e^{20} = average emissions of top 20%, e* = specific emissions of best plant, c_i = output of plant i, e_i = specific emissions of plant i

Example:

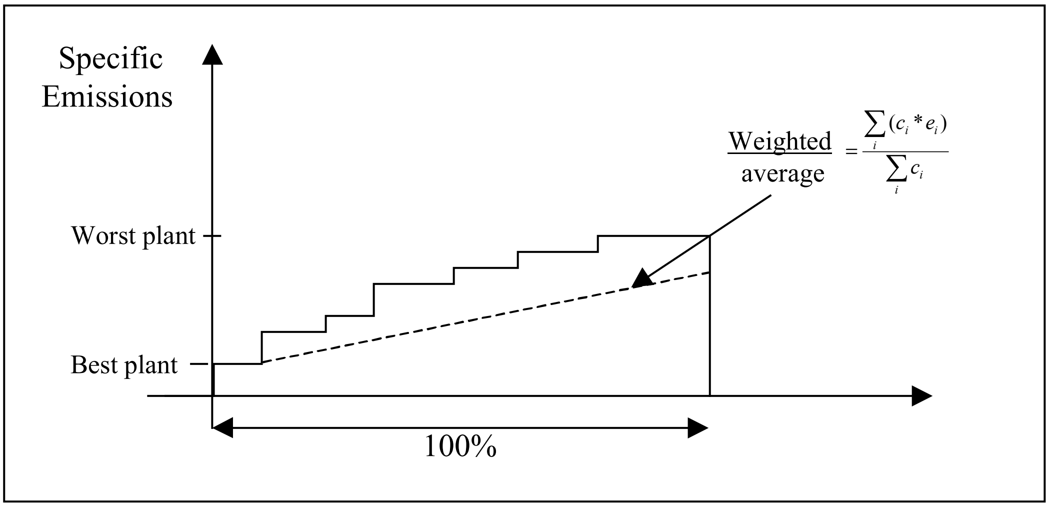


Fig. 3: Weighted average during the last 60 month forming the basis for the determination of top 20 %

d) As it does not seem possible to take into account **all** plants throughout the world with justifiable efforts, only those plants that have a capacity of more than 1000 tpd shall be considered as long as the CDM project itself produced more than 5%. For projects with a capacity below 1000 tpd only plants with a capacity below this threshold are to be considered. This threshold has been chosen firstly because only the large plants actually compete on the world market for methanol and secondly due to the fact that there are two distinct size classes of methanol plants, one above 1000 t per day and one below 600 t per day. This allows to compare small plants with small plants and large plants with large plants, to reasonably limit transaction costs and at the same time to cover similar installations.

2.2. Overall description (other characteristics of the approach):

Introduction

Methanol may generally be produced from fossil fuels, waste or biomass. However, today large scale production is almost always based on natural gas (> 85 % of world-wide installed capacity).

There are two main process principles for converting natural gas to methanol at low costs in large quantities:

1. Oxygen blown natural gas reforming

2. Steam reforming

The latter has a share of global installed gas-based capacity of over 90%.

By introducing additional carbon dioxide or hydrogen rich gases into the steam reforming process the carbon intensity of methanol production can be improved. (It should be noted that this is only technically feasible/reasonable for steam reforming plants.) If the gases added are taken from a source emitting anyway, such a project results in a net reduction of carbon dioxide emissions.

Methanol production by steam reforming

Methanol production by steam reforming basically consists of the following main steps:

- Feedstock Preparation
- Production of Synthesis Gas
- Synthesis gas compression and Crude methanol synthesis
- Production of Refined Methanol
- Storage and export of Product Methanol

Feedstock preparation: Natural gas supplied to the Plant is compressed to the required feed pressure in a centrifugal compressor. The feed natural gas is heated up before passing over a catalyst bed where complex compounds are reacted with hydrogen to convert any sulphur in the gas to hydrogen sulphide which is subsequently removed by absorption over zinc oxide.

Production of synthesis gas: The natural gas is reacted with steam in two reaction stages to a mixture of basic components. This reaction process is referred to as steam reforming and converts the natural gas into a mixture of carbon oxides, hydrogen and residual methane and contains water in the form of steam. The resulting mix of carbon oxides and hydrogen is referred to as synthesis gas as these are the key components for the synthesis of methanol.

The gas stoichiometry can be defined using the R ratio as follows.

$$R = \frac{H_2 - CO_2}{CO + CO_2}$$

Synthesis gas compression and Crude methanol synthesis: The methanol synthesis reactions take place over a suitable catalyst given the appropriate controlled reaction conditions. A circulating gas stream is used to return unconverted reactants back to the methanol reactor after separation of crude methanol product by cooling. The synthesis gas also contains non reactive components (inerts) in the form of nitrogen and any remaining methane from the natural gas feed which has not been broken down earlier in the process, a small gas purge taken before recycle of the unconverted feed prevents these components from building up.

Production of Refined Methanol: The crude methanol contains impurities (which are more volatile than pure methanol) and heavy end impurities (which are less volatile than methanol) together with traces of dissolved gases from the methanol synthesis stage. The dissolved gases and light ends including ketones and aldehydes are removed in the topping column which separates them into an overhead vapour stream.

The refining column removes remaining heave end impurities to produce a high quality refined methanol product. The impurities are removed as two liquid streams consisting of a small flow of heavy organic by-products known as fusel oil and a much larger flow of water containing traces of miscible organic components.

Storage and export of Product Methanol: The refined methanol is stored in shift tanks for analysis before it is pumped to product storage tanks. The product is ultimately exported using the methanol loading pumps to send product via a new high capacity loading line routed from product tankage to the new ship loading arm located on the jetty.

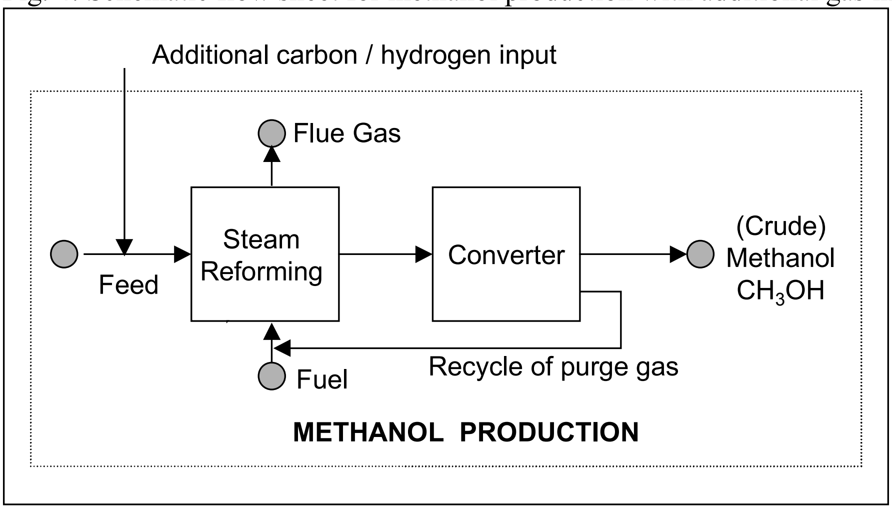
Conventional steam reforming

Conventional steam reforming is the simplest and most widely practised route to synthesis gas production. The process results in a considerable hydrogen surplus. The ballast effect of hydrogen surplus necessitates larger dimensions in both the front end and the synthesis loop and causes energy penalties during operation. In order to prevent hydrogen from accumulating in the loop, modifications as carbon dioxide additions or combined reforming[7] can be introduced.

Additional carbon and hydrogen input

The rate of carbon and /or hydrogen addition is controlled to give the desired ratio R of hydrogen to carbon oxides in the synthesis gas for methanol synthesis. This can yield both an improved methanol conversion efficiency as well as an overall CO_2 emission reduction. The overall process is depicted in Fig. 4.

Fig. 4: Schematic flow sheet for methanol production with additional gas input.



3. Key parameters/assumptions (including emission factors and activity levels), and data sources considered and used:

[7] I.e. oxygen blown operated reformer as mentioned above.

The key parameters are the material flows used in the core process, i.e.

Direct carbon input:
- Natural gas (feed and fuel)
- CO_2 introduced
- Purge gases

Indirect input:
- Substitutes for purge gas removed
- Other supplies as long as they are found to change significantly due to the change of the steam reforming process.

Direct output:
- CO_2 flue gas
- Methanol

Indirect outputs:

-

An important point to be mentioned is the assumption[8] that the world methanol market is growing in the future. If on the other hand the market is stable or even decreasing the new plant would displace production from existing plants. This would, however, not result in unjustified emission reductions as it is reasonable to presume that old, inefficient plants would be driven out of the market[9] and thus even more reductions would be yielded.

4. Definition of the project boundary related to the baseline methodology:

(Please describe and justify the project boundary bearing in mind that it shall encompass all anthropogenic emissions by sources of greenhouse gases under the control of the project participants that are significant and reasonably attributable to the project activity. Please describe and justify which gases and sources included in Annex A of the Kyoto Protocol are included in the boundary and outside the boundary.)

The principal process route has been described above. Apart from the related basic material flows, a lot of other side streams (process and auxiliary materials) can generally be determined as for example electricity consumption.
However, only the emissions from the change of **core process** itself shall be considered as this is the overall project idea. Side streams (e.g. electricity) shall only to be determined and to be taken into account when they are influenced **significantly due to the additional carbon introduction**. A significant influence is an emissions change of more than 1% of total emissions of the methanol plant. The rationale behind this proposal is the fact that many side streams strongly depend on the site conditions but are not influenced by the *change of the core process = project activity*.[10] It seems unlikely that an investor decides in favour of a certain location only due to the fact that (indirect) emissions from

---

[8] Take from an independent market observer / consultancy.

[9] This becomes obvious as natural gas is one of the most important feature of the operating costs. Inefficient plant → high natural gas consumption → high cost → end of production.

[10] For example, a plant built in Oman requires huge a amount of electricity for operating a reverse osmosis plant for water production. This only depends on the location and not the process chosen. Furthermore, this would be required for both, a conventional and new plant.

side streams are lower than elsewhere (see discussion of baseline option (b) for decision parameters). Furthermore, for baseline option c) it seems impossible to determine all site specific emissions from all relevant plants throughout the world.

5. Assessment of uncertainties:

(Please indicate uncertainty factors and how those uncertainties are to be addressed)

With regard to the data acquisition of the new plant, only very little uncertainties are to expected: Measuring of relevant material streams is possible without any problems as measuring equipment is technologically proven. Error of calibrated instruments are known and will be taken into account appropriately.

The development of the future methanol market and resulting uncertainties has already been discussed in section 3 “key parameter”.

It might be difficult to get the emission intensity of the plant building the basis for quantifying emission of the “top 20%” as there is generally no legal requirement to report specific CO_2 emissions and as operators might be reluctant to provide these figures. In case that this problem is faced, the project developer may present an indirect way of calculating the figures required. However, a conservative approach shall be followed.

6. Description of how the baseline methodology addresses the calculation of baseline emissions and the determination of project additionality:

(Formulae and algorithms used in section E)

The baseline is calculated as follows:

$$E^B = e^s * x^p$$

where E^B total CO_2 emissions of the reference scenario (t CO_2); e^s = average specific CO_2 emissions from steam reforming plant (...) whose performance is among the top 20% of their category (t CO_2 / t CH_3OH); x^p = total methanol production by the new project (t methanol)

Project emissions amount to:

$$E^P = e^p * x^p$$

where E^P = total CO_2 emissions of the project (t CO_2); e^p = specific CO_2 emissions of the new plant (t CO_2 / t methanol)

The reduction by the project can be calculated by deducing the project emissions from the baseline emissions, i.e.:

$$E^R = E^B - E^P$$

If E^R greater than zero, the project is additional (in terms of environmental additionality).

7. Description of how the baseline methodology addresses any potential leakage of the project activity:

(*Please note: Leakage is defined as the net change of anthropogenic emissions by sources of greenhouse gases which occurs outside the project boundary and which is measurable and attributable to the CDM project activity.)*

(Formulae and algorithms used in section E.5)

Leakage can occur if a process change leads to an increase in emissions outside the project boundaries, for example due to the increased use of intermediary inputs. Thus increases in electricity consumption and other inputs can lead to leakage. However, leakage shall only be considered if it is significant. This has been described above (see chapter on project boundaries).
As the new plant is more efficient, there will be less natural gas (feed and fuel) needed compared to conventional plants. This in turn may result in reduced upstream GHG emissions as for example methane losses from gas wells or piping. This positive spillover is not considered, showing a conservative approach.
Downstream emissions (for example from product transportation) are not considered neither as they would occur anyway, i.e. with a conventional plant, too.

Market effects of an increased methanol production due to the project (decrease in world market prices and subsequent increased demand elsewhere) shall not be accounted for.

8. Criteria used in developing the proposed baseline methodology, including an explanation of how the baseline methodology was developed in a transparent and conservative manner:

The baseline methodology was developed using the experience from pilot projects as for example the Prototype Carbon Fund, the Dutch Erupt/Cerupt programme and the Hamburg CO_2 Competition as well as the engineering skills of the project developer. Whenever calculations or assumptions had to been made, a conservative approach was used (see other section where procedures for deriving figures have been explained.)

9. Assessment of strengths and weaknesses of the baseline methodology:

The strength of the methodology is that all data concerning the project itself can be retrieved without problems as measuring of material flows causes no problems due to mature measurement instruments. The concentration on the core process only may seem unusual in the first moment. However, as more remote processes only depend on site-specific characteristics that do not influence the specific emissions of the process category nor the investors decision for the choice of a certain location this approach is judged to be acceptable. As the methanol market is a world market and as thus plants throughout the world have generally to be considered in calculating the baseline, gathering data for all side stream related emissions would even be impossible with regard to transaction costs.

10. Other considerations, such as a description of how national and/or sectoral policies and circumstances have been taken into account:

The baseline methodology is universally applicable in countries with a non-distorted investment climate. It should not be applied in countries that promote specific feedstocks or regulate the technology to be used for new methanol plants.

Annex 4

NEW MONITORING METHODOLOGY

Proposed new monitoring methodology

(Please provide a detailed description of the monitoring plan, including the identification of data and its quality with regard to accuracy, comparability, completeness and validity)

1. Brief description of new methodology
(Please outline the main points and give a reference to a detailed description of the monitoring methodology).

In order to assure that the reductions claimed are realised after the project's implementation, a complete carbon balance for the core process has to be made up.
Data quality (accuracy) depends on the concrete equipment used for measuring[11]. However, it should not be prescribed in a general methodology description – that has to be applicable for all similar projects - what specific devices have to be used. It should simply be a sound, technically proven apparatus the quality class of which has to be considered in the calculus of error.
As methanol plants of this size are operated stationary (about 350 days per year) the measurement of mass flows can be limited to a frequency or one time per week.

2. Data to be collected or used in order to monitor emissions from the project activity, and how this data will be archived

(Please add rows to the table below, as needed)

[11] For example: Measuring orifice, turbine gas meter, anemometer etc..

ID number *(Please use numbers to ease cross-referencing to table 5)*	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data kept?	Comment
1a	*Volume flow*	*CO_2 feed*	*m^3/h*	*m*	*At least Weekly*		*Electronically*	*	
1b	*Concen tration*	*CO_2 feed*	*kg/m^3*	*m*	*At least Weekly y*		*Paper*	*	
2	*Mass flow*	*CO_2 in flue gas*	*kg/h*	*c*	*At least Weekly*		*Electronically*	*	*Calculating CO_2 in the flue gas provides figures at least as accurate as measuring:A<u>all other</u> relevant streams are generally easier to measure and need to be measured very accurately for optimal operation control and/or for commercial reasons.*
3a	*Volume flow*	*Methanol in productstre am*	*M^3/h*	*m*	*At least Weekly*		*Electronically*	*	
3b	*Concen tration*	*Methanol in productstre am*	*t/m^3*	*m*	*At least Weekly*		*Paper*	*	
4a	*Volume flow*	*Natural gas (fuel)*	*M3/h*	*M*	*At least Weekly*		*Electronically*	*	
4b	*Concen tration*	*Natural gas (fuel))*	*Mol/m^3*	*m*	*At least Weekly*		*Paper*	*	
5a	*Volume Flow*	*Purge Gas*	*M3/h*	*m*	*At least Weekly*		*Electronically*	*	
5b	*Concen tration*	*H_2 and CH_4 in purge gas*	*Mol/m^3*	*m*	*At least Weekly y*		*Paper*	*	
6a	*Volume flow*	*Natural gas (feed)*	*M3/h*	*M*	*At least Weekly*		*Electronically*	*	
6b	*Concen*	*Natural gas*	*Mol/m^3*	*m*	*At least At*		*Paper*	*	

	tration	*(feed))*			*least* **Weekly*				

** = two years after the end of the crediting period or the last issuance of CERs for this project activity, whatever occurs later.*

3. Potential sources of emissions which are significant and reasonably attributable to the project activity, but which are not included in the project boundary, and identification if and how data will be collected and archived on these emission sources
(Please add rows to the table below, as needed.)

All emissions that are significant and reasonably attributable to project activity shall be included in the project boundaries.

ID number *(Please use numbers to ease cross-referencing to table D.6)*	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	For how long is archived data to be kept?	Comment

4. Assumptions used in elaborating the new methodology:

(Please list information used in the calculation of emissions which is not measured or calculated, e.g. use of any default emission factors)

There actually no assumptions made. All measurement techniques describe have been developed over years and are currently used in all industries throughout the world.

5. Please indicate whether quality control (QC) and quality assurance (QA) procedures are being undertaken for the items monitored. *(see tables in sections 2 and 3 above)*

Data *(Indicate table and ID number e.g. 3.-1; 3.-2.)*	Uncertainty level of data (High/Medium/Low)	Are QA/QC procedures planned for these data?	Outline explanation why QA/QC procedures are or are not being planned.
1a, 3a, 4a, 6a, 6a,	*low*	*All measurement instruments are calibrated according to international standard?*	*High quality data is in the operator's interest as it is needed to operate the plant efficiently and thus at least costs.*
1b. 3b. 4b. 5b. 6b.	*Low*	*Staff for sample taking will be*	*The laboratory shall be work according to international standards, quality*

		trained appropriately, manuals are to be provided	*regulations have to be provided.*

6. What are the potential strengths and weaknesses of this methodology? *(please outline how the accuracy and completeness of the new methodology compares to that of approved methodologies).*

The strength is clearly that measuring the mass flows described is proven technology applied throughout the world. The weakness – as for all technical devices - is that they might break down so that the data required would not be available. This would, however, in the worst case result in not certification of emission reductions claimed.

7. Has the methodology been applied successfully elsewhere and, if so, in which circumstances?

As already mentioned measuring the mass flows described is mature technology applied throughout the world. The majority (if not all) methanol plants dispose of such kind of monitoring.

After completing above, please continue filling sub-sections D.2. and following.

Annex 5

TABLE: BASELINE DATA

(Please provide a table containing the key elements used to determine the baseline (variables, parameters, data sources etc.). For approved methodologies you may find a draft table on the UNFCCC CDM web site. For new methodologies, no predefined table structure is provided.)

No.	Name	Notation	Source	Comments
1	Average specific emissions of project activity	t CO_2 / t CH_3OH	Metering /calculation	CO_2 emissions are calculated, all other figures required are measured.
2	Methanol production	t CH_3OH	Metering	
3	Average specific emissions of similar projects undertaken...(option (c))	t CO_2 / t CH_3OH	Calculation	

- - - - -