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# CDM Validation Report

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Audit/Assessment:

CDM Validation

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Team of auditors/assessors:

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**Approved by**

**Date**

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02/11/2012



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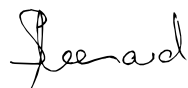
12/11/2012



Mr Oliver Stankiewicz

Executive Board:

12/11/2012



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## Table of Contents

1	Introduction.....	3
1.1	Objective.....	3
1.2	Scope .....	3
1.3	Project description.....	3
1.4	Validation methodology.....	5
2	Validation Opinion .....	7
2.1	Summary of the validation conclusions.....	7
2.2	Summary of the validation methodology and process used and the validation criteria applied .....	7
2.3	Description of project components or issues not covered by the validation process .....	7
2.4	Statement on the validation of the expected emission reductions.....	7
2.5	Statement whether the proposed CDM project activity meets the stated criteria.....	8
3	Validation Findings .....	9
3.1	Approval .....	9
3.2	Participation .....	9
3.3	Project design document.....	11
3.4	Project description.....	13
3.5	Baseline and monitoring methodology .....	13
3.6	Additionality of project activity .....	38
3.7	Monitoring plan.....	53
3.8	Sustainable development .....	60
3.9	Local stakeholder consultation .....	60
3.10	Global stakeholder consultation.....	60
3.11	Environmental impacts.....	60
3.12	Validation protocol.....	62
4	List of Interviewees and Documents Reviewed .....	63
5	Validation Team and Reviewer.....	63
6	Quality Control.....	63
7	Appendix A: On-Site Visit Program.....	64
8	Appendix B: Interviews .....	65
9	Appendix C: Documents Reviewed .....	66
10	Appendix D: Certificates of Competence.....	69
11	Appendix E: Abbreviations .....	72
12	Appendix F: Validation Protocol	

## 1 Introduction

### 1.1 Objective

Grütter Consulting has retained SQS to validate the Busan Metro Line 1 Dadae (the project). The objective of the validation is an independent assessment by a Designated Operational Entity (DOE) of a proposed project activity against the defined set of criteria for registration under the Clean Development Mechanism (CDM). Validation is part of the CDM project cycle and will finally result in a conclusion by the DOE whether a project activity should be submitted for registration to the CDM Executive Board (CDM EB). The ultimate decision on the registration of a proposed project activity rests with the CDM EB.

### 1.2 Scope

The scope of the validation is an independent and objective review of the project design document (PDD) and the DOE uses a risk-based approach focusing on the identification of significant risks for project implementation and the generation of Certified Emission Reductions (CERs) against the criteria stated in

- The Kyoto Protocol, in particular § 12 and Modalities and Procedures for the Clean Development Mechanism
- Decision 2/CMP.1 and Decision 3/CMP.1 (Marrakech Accords)
- Modalities and Procedures for a Clean Development Mechanism
- Clean Development Mechanism Validation and Verification Manual (VVM version 01.2)
- GLOSSARY OF CDM TERMS, version 06
- ACM0016 "Baseline Methodology for Mass Rapid Transit Projects", version 2.0
- Tool to calculate baseline, project and/or leakage emissions from electricity consumption, version 01
- Tool for the demonstration and assessment of additionality version 05.2.1
- GUIDELINES ON THE DEMONSTRATION AND ASSESSMENT OF PRIOR CONSIDERATION OF THE CDM, version 04
- GUIDELINES ON THE ASSESSMENT OF INVESTMENT ANALYSIS, version 05
- Decisions and specific guidance by the EB published under <http://cdm.unfccc.int>

A comprehensive list of the normative references given in the validation protocol (Appendix F).

### 1.3 Project description

The objective of the project is to establish and operate an efficient, safe, rapid, convenient, comfortable and effective modern mass transit system with high ridership capacity in Busan, Korea. The project metro is an extension of Line 1 with 6 additional stations linking Sinpyeong to Dadae.

The city of Busan has around 3.7 million inhabitants. The southern extension of Line 1 is fully underground with a length of 8 km and 6 stations expecting to transport in the first operational year around 18 million passengers. Busan has already 4 metro lines operational as well as a LRT line.

The owner of the system is the Busan Metropolitan City through Busan Transportation Corporation (BTC), which constructs and operates the metro. BTC is a Public Corporation established by Busan Metropolitan City. Busan Transportation Corporation was created in accordance with the "Local Public Organizations Act" with the purpose of promoting public transport facilities and the welfare of citizens of Busan. BTC is thereby in charge of constructing and operating the metro, bus transport in lines, which do not overlap existing bus lines, parking lot installation and management and in general public transit promotion.

The **baseline situation** is a continuation of traditional modes of transport including buses, taxis, private cars, motorcycles and bicycles. As of 2011, Busan had around 1.2 million vehicles including around 900 000 passenger cars, 25 000 taxis, 2 500 buses, and around 110 000 motorcycles. In absence of the project, the passengers move from their trip origination to their trip destination by buses, by taxis, by passenger cars, by the existing lines of metro and by NMT (Non Motorized Transport). In the baseline situation, these modes of transport would continue to operate and transport passengers from their trip origin to their trip destination. The baseline scenario is comparable to the situation prior to the project. The baseline scenario, however, incorporates technological advancements in terms of emissions per distance driven of various modes of transport as well as eventual fuel changes of baseline modes of transport during the project activity.

In the **project situation**, the metro complements other modes of transport and replaces partially trips made by conventional or traditional means of transit by metro, being a more efficient, faster, safer and more reliable transport means.

**Emission reductions** are achieved through reducing GHG emissions per passenger-kilometre, comparing conventional modes of transport with metro. The metro has as main environmental aspect that the resource efficiency of transporting passengers in Busan is improved i.e. emissions per passenger kilometre are reduced compared to the situation without project. This is realized through following changes:

- Improved efficiency: Metro has lower GHG emissions per passenger-kilometre compared to other modes of transport used in absence of the project.
- Mode switching: The MRTS is more attractive to clients due to reduced transport times, increased safety and reliability. It can thus attract private car, taxi or bus users with higher emission rates to switch to MRTS.
- Load increase or change in occupancy: The MRTS has a centrally managed organization dispatching trains not available in the current bus based mass transit system. The occupancy rate of vehicles can thus be increased due to organizational measures.

**Environmental improvements** are achieved through less GHG and other air pollutant emissions, specifically particle matter, SO<sub>2</sub> and NO<sub>x</sub>. This is achieved through a more efficient transport system and through using electricity as energy source.

The **social impact** of metro is basically improved social wellbeing as a result of less time lost in congestion, less respiratory diseases due to less particle matter pollution, and fewer accidents per passenger transported.

Expected is also an improved economic performance of the city, basically due to less congestion and due to having a modern public transit system with its corresponding positive image. A monetary quantification of these benefits is complex and prone to discussions as developments of the same parameters also take place in absence of the project and a monetization of non-market traded benefits (e.g. estimation of the value of time savings) can lead to differing results depending on the approach used. Nevertheless, it is clear in a qualitative sense that the project contributes to economic benefits. Latter are basically public goods and cannot be captured effectively by metro through ticket charges as benefits are accrued by users as well as non-users of metro.

The project reduces on average 10 206 tCO<sub>2</sub> per year in the crediting period.

Baseline and project emissions calculation as well as leakage and monitoring are based on the approved CDM methodology ACM0016, version 02 "Baseline Methodology for Mass Rapid Transit Projects", which is valid until 25/07/2012.

The project starting date was 04/11/2009, the first seven year period starts on 01/01/2014 or after the actual operational starting date.

The geographical boundary of the project is the Metropolitan Area of Busan in the region of Yeongnam, gases include CO<sub>2</sub> and CH<sub>4</sub>. The geographical coordinates of the Headquarters of BTC are 35°08'59" North and 129°03'38" East equivalent to Latitude 35.1497 and Longitude 129.0606.

Project participants are

- Busan Transportation Corporation (BTC), private entity, Republic of Korea; and
- South Pacific Inc., private entity, Republic of Korea.

## 1.4 Validation methodology

The DOE applies standard auditing techniques to assess the correctness of the information provided by the project participants, including, where appropriate, but not limited to:

- a) Document review, involving: review of data and information to verify the correctness, credibility and interpretation of presented information and cross checks between information provided in the PDD and information from sources other than that used, if available, and if necessary independent background investigations.
- b) Follow-up actions (on-site visit, telephone, email interviews), including: interviews with relevant stakeholders in the host country, personnel with knowledge of the project design and implementation and cross checks between information provided by interviewed personnel to ensure that no relevant information has been omitted from the validation.
- c) Reference to available information relating to projects or technologies similar to the proposed CDM project activity under validation.
- d) Review, based on the approved methodology being applied, of the appropriateness of formulae and correctness of calculations.

If, during the validation of a project activity, the DOE identifies issues that need to be further elaborated upon, researched or added to in order to confirm that the project activity meets the CDM requirements and can achieve credible emission reductions, the DOE shall ensure that these issues are correctly identified, discussed and concluded in the validation report.

The DOE shall raise a corrective action request (CAR) if one of the following occurs:

- a) The project participants have made mistakes that will influence the ability of the project activity to achieve real, measurable additional emission reductions;
- b) The CDM requirements have not been met;
- c) There is a risk that emission reductions cannot be monitored or calculated.

The DOE shall raise a clarification request (CL) if information is insufficient or not clear enough to determine whether the applicable CDM requirements have been met.

The auditor shall raise a forward action request (FAR) during validation to highlight issues related to project implementation that require review during the first verification of the project activity. FARs shall not relate to the CDM requirements for registration.

The project participant shall respond to all requests with sufficient evidence.

The DOE shall resolve or "close out" CARs and CLs only if the project participants modify the project

design, rectify the PDD or provide adequate additional explanations or evidence that satisfy the DOE's concerns. If this is not done, the DOE shall not recommend the project activity for registration to the CDM Executive Board.

In order to ensure transparency, a validation protocol was customized for the project. The protocol shows, in a transparent manner, criteria (requirements), means of validation and the results from validating the identified criteria. The validation protocol serves the following purposes:

- It organizes, details and clarifies the requirements a CDM project is expected to meet;
- It ensures a transparent validation process in which the DOE will document how a particular requirement has been validated and the result of the validation;
- The validation protocol consists of several tables, as described below.

The completed validation protocol is enclosed in appendix F to this report.

<b>CDM Validation Protocol, Chapters 1 - 3: Requirements</b>	
<i>Requirement</i>	The requirements the project must meet.
<i>Ref.</i>	Reference to the PDD or documents.
<i>MoV (Means of Validation)</i>	Explains how conformance with the requirements is investigated. DR = Document Review, I = Interview, N/A = Not Applicable
<i>Comment</i>	The Section is used to elaborate and discuss the conformance to the requirement.
<i>Draft Concl. / Final Concl. (Draft and/or Final Conclusion)</i>	OK = Conform, CAR = Corrective Action Request, CL = Clarification Request, FAR = Forward Action Request

<b>CDM Validation Protocol Chapter 4: Summary of Requests</b>	
<i>No.</i>	The requests (CAR, CL, FAR) are numbered and listed in this Section.
<i>Ref.</i>	Reference to the requirement number in Protocol 1 - 3 where the request is explained.
<i>DOE request</i>	The Section is used to elaborate and discuss the request. The DOE may give reference to the PDD or documents.
<i>Project participant response</i>	The responses given by the project participants during the communications with the DOE is summarized in this Section.
<i>DOE conclusion</i>	This Section should summarize the DOE's responses and final conclusions. The conclusions should also be included in Protocol 1 - 3, under "Final Conclusion".
<i>Date</i>	Date when request was closed.

## 2 Validation Opinion

### 2.1 Summary of the validation conclusions

SQS has performed a validation of the project's approach as outlined in the PDD being part of the CDM validation process. This validation was performed on the basis of appropriate criteria. SQS used the approved CDM methodology ACM0016 Version 2 including the therein referenced tools as the project-criteria for the validation.

The review of the PDD, the additional information gathered during the subsequent on-site inspection and the satisfaction of corrective actions and clarification requests has provided SQS with sufficient evidence in order to be able to determine the fulfillment of stated criteria. In SQS' opinion, the project, as outlined in the PDD version 1.6 as of 17/10/2012 [87], is consistent with the methodology mentioned. The project correctly applies the approved CDM methodology and therein baseline, additionality and monitoring principles.

The project activity results in reduction of greenhouse gas emissions that are real, measurable, additional and give long-term benefits to the mitigation of climate change. Information and data supporting the GHG ascertain are mostly historical in nature. They are based on official data, surveys and projections.

An analysis of the additionality test demonstrates that the proposed project activity is not a likely baseline scenario. Emission reductions attributable to the project are hence additional to any that would occur in the absence of the project.

The total emission reductions due to the project activity are estimated to be 71 442 tons CO<sub>2e</sub> over the entire crediting period of 7 years or 10 206 tCO<sub>2e</sub> per year. The estimated emission reduction was checked, and it is deemed likely that the stated amount is achieved, given that the underlying assumptions do not change. Adequate training and monitoring procedures have been implemented and will be supervised by the involved project entities.

In summary, it is SQS' opinion that the project „Busan Metro Line 1 Dadae“, as described in the PDD version 1.6 as of 17/10/2012 [87], meets all relevant requirements and criteria listed in Appendix F. The selected CDM methodology ACM0016 version 2.0 is applicable for the proposed CDM project activity and is correctly applied. Therefore, SQS requests the registration of the given CDM project.

### 2.2 Summary of the validation methodology and process used and the validation criteria applied

The validation process was carried out using the methodology described in 1.4; this included a comprehensive desk review by 2 auditors, an on-site visit of 1 day by the same 2 auditors on 06/02/2012, and a thorough analysis of the raised CL/CAR (1 CAR, 39 CLs, 1 FAR), where all of them could be closed. See Appendix F.

### 2.3 Description of project components or issues not covered by the validation process

All project components have been covered by the validation process.

### 2.4 Statement on the validation of the expected emission reductions

The expected emission reduction of 10 206 tCO<sub>2</sub> per year and 71 442 tCO<sub>2</sub> for the whole crediting period was found to be correct according to the validated assumptions. It is based on a preliminary survey at metro line 1 but not in the planned extension; the definitive survey could therefore lead to another result. For the moment, however, it is the best available estimation according to the opinion of SQS.

The emission reduction in the first PDD (version 1.0 of 12/11/2011) was about 7.5% higher; the reduction is mainly due to the adaption of passenger numbers and the inclusion of biodiesel in buses.

## 2.5 Statement whether the proposed CDM project activity meets the stated criteria

It is SQS' opinion that the project „Busan Metro Line 1 Dadae“, as described in the PDD version 1.6 as of 17/10/2012 [87], meets all relevant requirements and correctly applies the CDM methodology ACM0016 version 2.0; it is accurate, conservative, relevant, credible and reliable.



### 3 Validation Findings

#### 3.1 Approval

A letter of approval by the host country Republic of Korea was requested (CL 1) and issued on 18/07/2012 [82]. The Letter of Approval (LoA) /from the DNA of Republic of Korea consequently confirms in accordance with VVM Version 01.2 paragraph 45:

- Republic of Korea is a Party to the Kyoto Protocol (point 1 of LoA issued)
- The participation is voluntary (point 2 of LoA issued)
- The project contributes to sustainable development in the Republic of Korea (point 3 of LoA issued)
- The LoA refers exactly to the project title „Busan Metro Line 1 Dadae“

SQS confirms that the letter refers precisely to the proposed CDM project activity title in line with the title in the PDD „Busan Metro Line 1 Dadae“. In addition, the LoA statements are clear and unambiguous with respect to all required content such as Kyoto Protocol ratification status and voluntary participation. The LoA of the Republic of Korea also confirms that the proposed CDM project activity contributes to the sustainable development of the country.

The letter is considered as authentic without doubts and is unconditional. SQS received it from the project participant directly. The SQS validation team was able to confirm the authenticity of the LoA issued by the DNA of the Republic of Korea by a telephone call from the local expert to Mr. Jang, Jaewoo, the secretariat of the Ministry of Land, Transport and Maritime Affairs on 20/07/2012.

SQS confirms that the approval of participation is valid for the proposed project participants – see [82]. SQS confirms that the Letter of Approval is in accordance with paragraphs 45 – 48 of the VVM version 1.2 (EB 55, Annex 1, paragraph 49).

No.:	CL 1	Reference: VVM 44: Letter of Approval
Validator request:	Letters of Approval have not yet been submitted.	
Project owner response:	Only 1 LOA (from Korea) is required. To get the LOA the draft validation report is required.	
Validator conclusion:	LoA from the Republic of Korea received on 18/07/2012, CL 1 closed	Date: 18/07/2012

#### 3.2 Participation

See 3.1. The letter of approval of the host country Republic of Korea [82], dated 18/07/2012 No. 2012-19 Mentions the name of the participants. The modalities of communication were not yet available, CL 2 was raised; the document in the right form was delivered [77].

By reviewing the latest version of the completed modalities of communication form (F-CDM-MOC, version 01-3) signed by all project participants, SQS was able to confirm that this form is correctly completed. The names, authorized signatories and contact details of the project participants indicated in the MoC are consistent with the ones in the PDD.

No.:	CL 2	Reference:	MoC
Validator request:	The MoC document of the project has not yet been submitted		
Project owner response:	attached		
Validator conclusion:	Form F-CDM-MOC v01-3 was used, OK, CL 2 closed	Date:	25/04/2012

CL4 had to be raised, since there is not enough information about the organization between the city and the transportation corporation. The answer is: Busan Transportation Corporation was created in accordance with the "Local Public Organizations Act" with the purpose of promoting public transport facilities and the welfare of citizens of Busan. BTC is thereby in charge of constructing and operating the metro, bus transport in lines, which do not overlap existing bus lines, parking lot installation and management and in general public transit promotion. CL 4 could be closed.

No.:	CL 4	Reference:	PDD A.2 Description of the project
Validator request:	Insufficient information about the organization between the city and the transportation corporation		
Project owner response:	More information has been added in Section A.2.		
Validator conclusion:	Busan Transportation Corporation was created in accordance with the "Local Public Organizations Act" with the purpose of promoting public transport facilities and the welfare of citizens of Busan. Some more has been added to the PDD. OK, CL 4 closed	Date:	27/04/2012

### 3.3 Project design document

The official form "PROJECT DESIGN DOCUMENT FORM (CDM-PDD) version 03 - in effect as of: 28/07/2006" without any alteration was used for submitting the project. The "GUIDELINES FOR COMPLETING THE PROJECT DESIGN DOCUMENT (CDM-PDD) AND THE PROPOSED NEW BASELINE AND MONITORING METHODOLOGIES (CDM-NM) (version 07)" were followed for completing the PDD, no confidential information is contained in the PDD. The PDD is very comprehensive and contains with over 60 additional files an exceptional high level of proofs for all relevant statements.

Some minor corrections had to be made by the PP regarding the PDD (CL 3, CL 6, CL 12, CL 13, CL 22, CL 24, CL 29, CL 38). All corrections were performed by the PP and ended in the final version of the PDD [75].

No.:	CL 3	Reference:	PDD A 4.1.4
Validator request:	The geographical coordinates are not written in the correct format (x,yyyy) and are not representing the headquarter of the metro.		
Project owner response:	Has been updated		
Validator conclusion:	Correct format, CL 3 closed OK	Date:	25/04/2012

No.:	CL 6	Reference:	PDD A.4.3 (pre-project situation)
Validator request:	There are no motorized rickshaws and there are more than 2 MRTS.		
Project owner response:	Rickshaws has been corrected MRTs lines have been corrected.		
Validator conclusion:	PDD adapted, CL 6 closed	Date:	25/04/2012

No.:	CL 12	Reference:	PDD B2 map 3
Validator request:	Map 3 is not fully understandable, some explanations are missing		
Project owner response:	A new map has been included in the PDD		
Validator conclusion:	The new map is better understandable, CL 12 closed	Date:	25/04/2012

No.:	CL 13	Reference:	PDD B.4 Baseline identification, step 1
Validator request:	The mentioned feasibility reports are not included in the PDD as a document		
Project owner response:	The sentence has been deleted and replaced.		
Validator conclusion:	PDD adapted, OK, CL 13 closed	Date:	25/04/2012

No.:	CL 24	Reference:	PDD B.5 Map 4
Validator request:	The non-project points in the map are confusing. The mark for the affected road does not show the entire road.		
Project owner response:	The map has been replaced		
Validator conclusion:	New map is much clearer, OK, CL 24 closed	Date:	25/04/2012

No.:	CL 29	Reference:	PDD p. 37
Validator request:	There is no <b>table</b> with the measured circulating speed.		
Project owner response:	The sentence has been deleted. It is only 1 affected road and the speed of that road is included in the sentence thus no need for a table		

Validator conclusion:	Amendment of PDD OK, CL29 closed	Date:	25/04/2012
No.:	CL 22	Reference:	PDD p. 24
Validator request:	There is an addition in the last sentence of this page missing: "...in absence of CDM..."		
Project owner response:	Sentence has been added		
Validator conclusion:	PDD adapted, OK, CL 22 closed	Date:	25/04/2012

No.:	CL 38	Reference:	PDD and monitoring manual
Validator request:	The project titles are not identical throughout the documents.		
Project owner response:	MM has been amended		
Validator conclusion:	Now consistent, OK, CL 38 closed	Date:	25/04/2012

### 3.4 Project description

The project description (see 1.3 above) in the PDD is understandable and gives a good overall picture of the activities.

There are two CL concerning the project description in A.4 of the PDD, CL 7 and CL 8: CL7 asks about the data in Figure 1 and CL 8 asks about the modal split. Both CLs were answered and led to some small amendments of the PDD. Both CL could be closed.

There is insufficient information about the nature of the financing by the city government, CL 9 had to be raised. The answer was given by the project participant in CL 9 and the PDD was amended, CL 9 could be closed.

On 06/02/2012 the two auditors visited station 104 of the new extension of metro line 1. The construction site started in October 2010 and the level of the excavation was already around 16 metres under the surface. The final level of -25 metres will be reached according to the construction manager in around 4-5 months. The on-site visit and the interviews (see on-site visit program and interviews in Appendix A and B) have confirmed the project description. No contradictory information or findings have been unveiled.

No.:	CL 7	Reference: PDD A.4.3 (Figure 1)
Validator request:	It is not clear why there is only data up to 2006	
Project owner response:	Data is until 2009. No newer data than 2009 was available (the report was issued in 2010)	
Validator conclusion:	Explanation is satisfying, C L7 closed	Date: 25/04/2012

No.:	CL 8	Reference: PDD A.4.3 (pre-project situation)
Validator request:	It is not clear in which dimension the modal split rates are measured (passenger-rides, passenger*km, other?)	
Project owner response:	Passenger rides as is usual. Has been corrected	
Validator conclusion:	Figure 1 in PDD has been amended. CL 8 closed	Date: 27/04/2012

No.:	CL 9	Reference: PDD A.4.5 and B.5 Table 7
Validator request:	There is insufficient information about the nature of the financing by the city government. Is it a private or a government financing?	
Project owner response:	As indicated in Chapter B5 step 2 60% is financed by central government. 40% are financed by the City. This has been clarified. Table 7 clearly indicates Finance by Central Gov. and Finance by Municipality i.e. City of Busan. Section A.4.5. refers to public funding through ODA of an Annex I country. This is not the case as funds are from Korea. The 1 <sup>st</sup> sentence in A.4.5. has been deleted as wrong.	
Validator conclusion:	A.4.5. in PDD was corrected. CL 9 closed	Date: 28/04/2012

### 3.5 Baseline and monitoring methodology

#### 3.5.1 General requirement

The following methodology and adequate tools were applied:

- ACM0016, Baseline Methodology for Mass Rapid Transit Projects, version 2.0
- Tool for the demonstration and assessment of additionality, version 05.2.1

- Tool to calculate baseline, project and/or leakage emissions from electricity consumption, version 01  
The applied methodology was the newest available one when the project was started. It is valid until 25/07/2012. Thus, it is justified to still use it for this project although there is now a newer version available.

### 3.5.2 Applicability of the selected methodology to the project activity

The following table shows the applicability conditions of the proposed project:

Applicability condition	Project situation	Means of Validation
The project constructs a new rail-based infrastructure or segregated bus lanes. In the case of rail systems the project needs to provide new infrastructure (new rail lines). The segregated bus lanes or the rail-based MRTS replace existing bus routes operating under mixed traffic conditions.	The MRTS extension is new rail-based mass transit system. The rail infrastructure is new. The bus system is re-structured once the metro is operational. Re-structuring during construction and years prior operation makes no sense as bus routes change over time. The same procedure was followed by the former phased opening of the Busan metro lines 3 and 4. In Line 3 15 routes of buses were closed, 4 routes were changed in their routing and 2 routes changed the frequency of bus operations, while also 5 new routes were introduced to optimize integrated public transit. In line 4 overlapping bus routes were changed including route revoking and frequency changes.	The on-site visit showed that the new rail infrastructure is under construction. CL 10 was issued asking for more information about the replacing of the existing bus routes. Additional information was given in an official letter (file 54)[55]. OK
The methodology is not applicable for operational improvements (e.g. new or larger buses) of an already existing and operating bus lane or rail-based MRTS.	The MRTS is a new metro extension with new infrastructure.	Site visit, the MRTS is as extension with new stations and other infrastructure a new metro line. OK
The methodology is not applicable for bus lanes replacing an existing rail-based system.	The MRTS is rail-based and not a bus lane.	Site visit, the MRTS is rail based. OK
The methodology is applicable for passenger transport only.	The MRTS is a passenger transport system.	Site visit, the MRTS is planned as a passenger transport system. OK
Any fuels including electricity, (liquefied) natural gas and bio-fuel blends can be used in the baseline or project case. <ul style="list-style-type: none"> <li>• In case of natural gas, the methodology is applicable if equal or more natural gas is used in the baseline than in the project case. The methodology is not applicable in its current form if more natural gas is used in the project compared to the baseline case.</li> <li>• In the case of bio-fuels, project buses must use the same bio-fuel blend (same percentage of bio-fuel) as commonly used by conventional comparable urban buses in the country.</li> </ul>	Baseline transport fuels are diesel, gasoline and gaseous fuels. 2% bio-fuels are used currently in diesel in the baseline. The project uses electricity. Thus, more natural gas is used in the baseline than in the project case as passengers switch partially from buses and taxis, which use partially gaseous fuels to metro.	There was insufficient information about the possible actual and future use of bio-fuels for buses, therefore, CL 11 was raised. If in the future, a different blend of bio-fuel will be used. This will be monitored and the emission factors will be adjusted as mentioned in the methodology. OK
The methodology is not applicable for the implementation of air and water-based transport systems.	No air or water-based transport system is implemented. The MRTS is rail based.	Site visit: The MRTS is lead all underground. No air or water-based system is planned. OK
The project system partially replaces a traditional public transport system in a given city. The methodology cannot be used in areas where currently no public transport is available.	The MRTS replaces partially traditional bus trips. Public transport is currently available in the project area. Bus routes are existent in the area where the metro line will be established (see map below). Their replacement is discussed in point 1 of the applicability conditions.	Site visit: Busan has already a large public transport system with metro and bus lines. The replacement of bus lines

		when the extension of the metro line starts, is discussed with CL 10 above. OK
The methodology is applicable for urban or suburban trips. It is not applicable for inter-urban transport.	The MRTS is for urban or suburban trips.	Site visit: The MRTS is a real metro, no interurban transport is planned. OK
The methodology is only applicable if the application of the procedure to identify the baseline scenario results in that a continuation of the current public transport system is the most plausible baseline scenario.	The identified baseline is a continuation of the current urban transit system (see Section B.4).	No other baseline scenario than continuation of the current public transport system makes really sense. See Section B4. OK

The methodology includes the direct and indirect project GHG emissions as well as leakage. No further GHG emissions with a contribution of more than 1% are to be expected within the project boundary as a result of the project activity. SQS states that the applied methodology is justified and all applicability conditions are met.

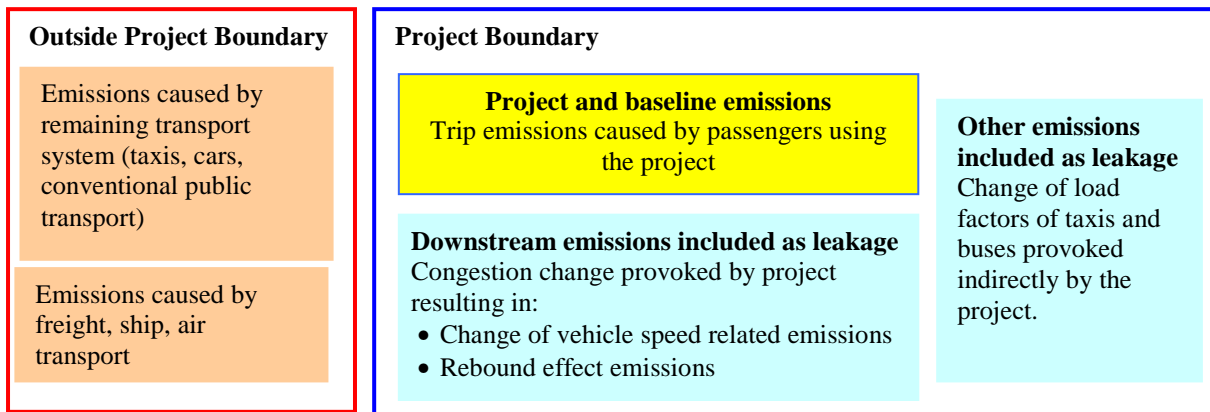
No.:	CL 10	Reference: PDD B.2 Table 2
Validator request:	There is insufficient information about how the bus system is planned to be restructured.	
Project owner response:	As explained with the line 3 and line 4 as a sample, once the construction has finished the feasibility study will be realized for reform of the bus routes for Dadae line. Please refer to Excel sheet line 3 and 4 of File 54. More information has been added to the PDD.	
Validator conclusion:	The following sentences were added to the PDD: "The same procedure was followed by the former phased opening of the Busan metro lines 3 and 4. In Line 3 15 routes of buses were closed, 4 routes were changed in their routing and 2 routes changed the frequency of bus operations, while also 5 new routes were introduced to optimize integrated public transit. In Line 4 overlapping bus routes were changed including route revoking and frequency changes." CL 10 closed, OK Date: 25/04/2012	

No.:	CL 11	Reference: PDD B.2 Table 2
Validator request:	There is insufficient information about the possible actual and future use of bio-fuels for buses. Specifically, it is not clear: - whether there is actually no use of bio-fuels for buses - what will happen to the project if in future the use of some bio-fuel would become mandatory for some motorized vehicles procedures	
Project owner response:	2% bio-fuel blend is used since 1.2012. See confirmation letter of public transportation system File 57. The CER spreadsheet and the PDD have been adjusted. If in the future a different blend of bio-fuel is used this is monitored and the BEF is adjusted (see p. 10 of the methodology and p. 29 of the methodology). For clarification this has been added also Section B.7.1. Parameter EF <sub>CO2</sub>	
Validator conclusion:	PDD tables [76] were corrected with the new bio-fuel blend of 2%. The PDD was amended only partly, since the summary table in B.6.2 uses still the old values. Date: 25/04/2012	
Project owner response:	The corrections have been made in PDD v1.2 of 29.04.2012	Date: 29/04/2012
Validator conclusion:	New PDD amended [75] CL 11 closed	Date: 29/04/2012

### 3.5.3 Project boundary

The spatial extent of the project according to the PDD is the Metropolitan Area of Busan, which corresponds to the methodology where the “LUZ larger urban zone” is mentioned. According to the methodology, version 2, a “larger urban zone (LUZ) of a city covers the whole functional zone around the city (including the core city) i.e. it corresponds to the commuting field around the city”; this was not mentioned clearly enough in the PDD version 1.0. Therefore, CL 5 was raised. An explanatory sentence was added in Chapter A4.1.4 of the PDD. The local expert agreed with the explanation. Therefore, CL 5 could be closed.

The conceptual project boundaries are given in figure 3 of the PDD:



The greenhouse gas emissions include CO<sub>2</sub> and CH<sub>4</sub>. N<sub>2</sub>O and tailpipe CH<sub>4</sub> are excluded since they contribute less than 2% to the total CO<sub>2eq</sub> emissions. They would be reduced by the project as well, thus, their omission is conservative and corresponds to the methodology.

The identified boundary and emission sources that will be affected by the project activity are thus justified. The national grid has correctly been taken into the project boundary. The boundary was verified during the on-site visit.

The choice of boundary, sources and gases corresponds to the methodology and is deemed correct by SQS.

No.:	CL 5	Reference:	PDD A.2 Description of the project
Validator request:	The context between a “larger urban zone LUZ” and the “metropolitan area of Busan” is not defined clearly enough.		
Project owner response:	Has been detailed.		
Validator conclusion:	An explanatory sentence was added in Chapter A2 of the PDD, CL 5 closed	Date:	25/04/2012

### 3.5.4 Baseline identification

The baseline identification was done according to the methodology:

#### Step 1: Identification of alternative scenarios to the proposed CDM project activity that are consistent with current laws and regulations

All options are identified that meet the same requirement as the proposed project activity. Alternatives assessed are public transport systems which are complemented with other modes of transport such as passenger cars, taxis, motorcycles, baseline metro and non-motorized transport:

1. The establishment of a BRT (Bus Rapid Transit);
2. The establishment of a different rail-based MRTS;
3. The continuation of the current public and individual transport systems, including (future) investments in



- road based infrastructure if applicable;
4. The proposed project activity being implemented at a later date in the future, without being registered as a CDM project activity;
  5. The project proposal not implemented as a CDM project activity.

All 5 alternatives are legal compliant and meet the same requirement as the proposed project activity since no evidence for a non-compliance could be detected during the on-site visit and the interviews.

The validation by desk review, on-site visit and interviews has not come up with other alternatives than those identified in the report.

## Step 2: Assessment of Options

The analysis of options identified in Step 1 is based on the "Tool for the demonstration and assessment of additionality", version 05.2.

Alternative 1, establishment of a BRT: Busan has already established 4 metro lines. Also, the project is an extension of a metro line and thus, it makes technically no sense to establish a different system.

Due to limited passenger carrying capacity, compared to the project requirement, this option does not seem to be feasible. The following table (table 4 in the PDD [4]) was cross checked by SQS with the mentioned references ([47], [48], [49], <http://www.chinabrt.org/>).

BRT Project	Phd
Ahmedabad, India	1 000
Amsterdam, Netherlands	1 000
Bangkok, Thailand	1 000
Beijing, China	4 000
Bogota, Colombia	42 000
Brisbane, Australia	7 000
Bucaramanga, Colombia	10 000
Cali, Colombia	12 000
Cartagena, Colombia	14 000
Changzhou, China	7 000
Dalian, China	6 000
Guadalajara, Mexico	9 000
Guatemala City, Guatemala	12 000
Guangzhou, China	27 000
Hangzhou, China	7 000
Hefei, China	3 000
Jakarta, Indonesia	4 000
Jinan, China	3 000
Kunming, China	4 000
Medellin, Colombia	7 000
Mexico City, Mexico	6 000-15 000 (according to line)
Nagoya, Japan	1 000
Nantes, France	1 000
Pereira, Colombia	7 000
Quito, Ecuador	6 000
<b>Seoul, Korea</b>	<b>7 000</b>
Xiamen, China	8 000
Zaozhuang, China	1 000
Zhengzhou, China	6 000
<b>Median</b>	<b>7 000</b>
<b>Range</b>	<b>1 000 – 42 000</b>

The median of the 29 cities lies at around 7 000 passengers per hour and direction, which is far too low compared to the required 49 000. BRT are basically used for secondary lines in large metropolitan cities and as main lines in smaller and medium sized cities. Furthermore, Busan already has a metro. An extension of the existent metro line makes the connectivity easier than with a completely new BRT system.

SQS therefore agrees with the PP that Alternative 1 is not feasible.

Alternative 2, establishment of other rail-based MRTS: As the project is the extension of an existing metro line it makes no technical sense for an 8km stretch to use a different rail-based system.

SQS agrees with the PP that alternative 2 is not feasible.

Alternative 3, continuation of the current system incl. future investments: A continuation of the current transport system complies with all applicable legal and regulatory requirements as could be shown by spot checks during the on-site visit and through discussions with the local expert. A continuation of the current system has various advantages compared to all other options:

- No large-scale public investment requiring additional income/tax sources.
- Lowest technical and financial risk of all options.

The carrying capacity of the current public transport system is in line with the actual transport demand. Increasing passenger demand can be accommodated through the establishment of new routes using also alternate roads, which might imply potentially longer travel distances complying, however, with the purpose of transporting passengers from their trip origin to their trip destination. Also under business as usual, the trend of decreasing mode share of public transit and increasing share of private transit would continue, as through economic development more people have the means to acquire and maintain a vehicle and would also use their private vehicle if no modern mass transit system with the required level of convenience, speed and comfort is available. Additional transit demand might also lead to increased trip times due to increased congestion.

Also, Busan is making heavy investments in new road infrastructure in order to make Busan a distribution hub in Northeast Asia. This indicates that investment in road-based transit will allow in the future for traffic accommodation also in absence of any new MRTS without major difficulties.

SQS states that continuation of the current system is the most plausible alternative to the project and can thus be considered as the baseline scenario.

Alternative 4, the project being realized in a later date without CDM: No national or local policy mandates the implementation of a MRTS. The obstacles faced today of a new metro line, being basically of financial nature, would be the same or even worse in the future. If no MRTS is established now, inhabitants of Busan would continue investing in private means of transit like in the past, where the mode split in favour of passenger cars has increased steadily over the last decade (see Figure 1, Section A.4.3.). This trend away from public towards private means of transit would continue. Once people own cars, it becomes more difficult to get them back on public transit and to achieve high passenger demand corridors. The trend in cities, including Busan, has been towards decreasing shares of public transit, thus making new MRTS not easier but more complex due to lack of passenger demand.

No regulations, laws or requirements exist that in the future MRTS need to build beyond general policy declarations, which are however non-binding. A project realization in the future without carbon finance is thus not planned. Implementing the metro in absence of carbon finance is also studied in Alternative 5.

SQS agrees with PP's argumentation that Alternative 4 is not feasible.

Alternative 5, the project without CDM: The arguments for the non-feasibility of this alternative are given mainly in Chapter B5 of the PDD and are of financial nature. SQS agrees; the financial proofs are discussed in 3.6.3.

**Step 3: If Step 2 results in more than one possible alternative baseline scenario, the most likely baseline scenario is the scenario with the lowest baseline emissions**

Alternatives 1 (Establishment of a BRT), 2 (Establishment of a LRT), 4 (Proposed project activity being implemented at a later date in the future, without being registered as a CDM project activity) and 5 (Project proposal not implemented as a CDM project activity) are not feasible. The most probable alternative in the future in absence of the project is therefore a continuation of the current transport system (alternative 3). This is thus the baseline for this project.

**Baseline Scenario**

Baseline emissions include the emissions that would have occurred due to the transportation of the passengers who use the project activity, had the project activity not been implemented. This is differentiated according to the modes of transport (relevant vehicle categories) which the passengers would have used in the absence of the project. The baseline is a continuation of the current transport system consisting of various transport modes between which the population chooses:

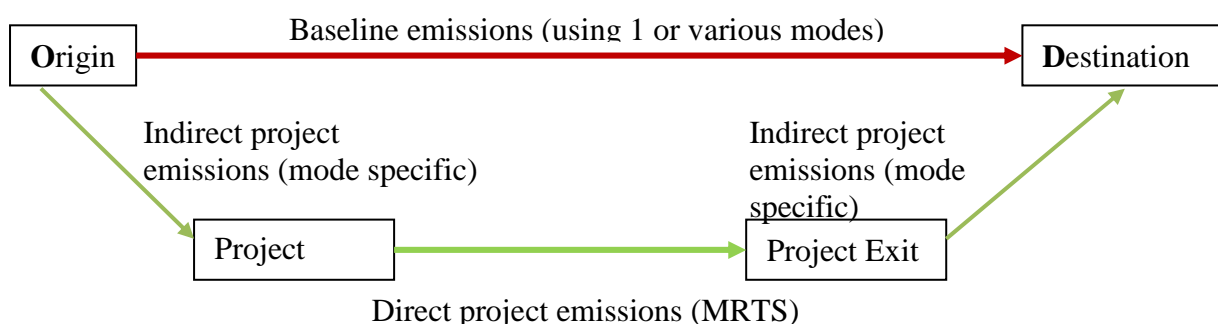
- NMT (Non-Motorized Traffic) with bikes and per foot;
- Private passenger car;
- Taxis;
- Motorcycles (two-wheelers);
- Buses;
- Existing metro network

For all above listed transport modes, the emissions per passenger kilometre (PKM) are calculated. To adjust for emission improvement under BAU, a technology improvement factor is applied to all road-based modes.

Baseline emissions are calculated per passenger surveyed. For each passenger surveyed, the individual baseline emissions are calculated and multiplied with the individual expansion factor, thus getting the baseline emissions of all passengers of the specific week surveyed.

Figure 6 provides an overview of baseline and project emissions, latter being differentiated in indirect and direct project emissions.

**Figure 6: Baseline and Project Emissions**



CL 14 was raised, since the proof for the decreasing share of public transit is rather old and comes from Seoul. The PDD was amended, the data are coming now from the "2010 Busan statistical yearbook", with database ending by 2009. CL 14 was closed.

CL 21 was raised, since the on-site visit but also documents in the PDD revealed that the end of construction would be late 2014; This means that the first crediting period cannot start in the beginning of 2014. The explanation of the PP was accepted and the starting date of the first 7-year period will be adapted to 01/01/2014 or based on the actual operational starting date. CL 21 was closed.

No.:	CL 14	Reference:	PDD B.4 Alternative 4
Validator request:	As a proof for a decreasing share of public transit file 24 is mentioned; the data in table 12 p.28 are rather old (1979 ... 1996) and were collected for Seoul.		
Project owner response:	Has been changed to File 20 which is for Busan and which has data until 2009		
Validator conclusion:	The footnote 15 has been changed, the data come now from the "2010 Busan statistical yearbook" with database ending by 2009. CL 14 closed	Date:	25/04/2012

No.:	CL 21	Reference:	PDD A4.4, Tables 11, 12 and tables in Annex 3
Validator request:	It is not clear why the crediting period starts already in 2014 since the expected starting date of the new extension is thought to be in end of 2014.		
Project owner response:	The operational start was projected to be 1.2014 (see FSR) and therefore the crediting period is also put as of this date. As explained in the former CAR in fact the construction start has around 1 year delay. This delay might potentially be caught up. If the project continues with the current delays the operational start will be end and not early 2014. In this case the crediting period will be changed after registration based on actual operational starting date		
Validator conclusion:	SQS agrees with this explanation that the starting date of the first 7-year period will be the 01/01/2014 <b>or based on the actual operational starting date.</b> CL 21 closed	Date:	25/04/2012

### 3.5.5 Algorithms and/or formulae used to determine emission reductions

Step 1 of the methodology requires that the PP defines alternatives to the project activity. This was done in Chapter B4. Only 2 of the 5 alternatives were credible, realistic and comparable:

1. Continuation of the current situation
2. Project without CDM

As outlined in 3.5.4, SQS agrees with this classification and proceeds to the investment analysis (3.6.3.) and to common practice analysis (3.6.4.).

Baseline emissions were calculated according to the methodology in B.6.1 as follows:

## BASELINE EMISSIONS

### Formulas

$$BE_y = \frac{P_y}{P_{SPER}} \sum_p (BE_{p,y} \cdot FEX_{p,y})$$

Where:

$BE_y$	Baseline emissions in the year $y$ (g CO <sub>2</sub> )
$BE_{p,y}$	Baseline emissions per surveyed passenger $p$ in the year $y$ (g CO <sub>2</sub> )
$FEX_{p,y}$	Expansion factor for each surveyed passenger $p$ surveyed in the year $y$ (each surveyed passenger has a different expansion factor)
$P_y$	Total number of passengers in the year $y$
$P_{SPER}$	Number of passengers in the time period of the survey (1 week)
$p$	Surveyed passenger
$y$	Year of the crediting period

$$BE_{p,y} = \sum_i BTD_{p,i,y} \cdot EF_{PKM,i,y}$$

Where:

$BE_{p,y}$	Baseline emissions per surveyed passenger $p$ in the year $y$ (g CO <sub>2</sub> )
$BTD_{p,i,y}$	Baseline trip distance $p$ per surveyed passenger using mode $i$ in the year $y$ (PKM)
$EF_{PKM,i,y}$	Emission factor per passenger-kilometre of mode $i$ in the year $y$ (g CO <sub>2</sub> /PKM)
$i$	Relevant vehicle category
$p$	Surveyed passenger
$y$	Year of the crediting period

$$EF_{PKM,i,y} = \frac{TE_{EL,i,y}}{P_{EL,i,y} \cdot TD_{EL,i}}$$

Where:

$EF_{PKM,i,y}$	Emission factor per passenger-kilometre of suburban rail/metro for year $y$ (gCO <sub>2</sub> /PKM)
$TE_{EL,i,y}$	Total emissions from suburban rail/metro for year $y$ (tCO <sub>2</sub> )
$P_{EL,i,y}$	Total passengers transported per year by suburban rail/metro for year $y$ (passengers)
$TD_{EL,i}$	Average trip distance of passengers using suburban rail/metro prior to project start (km)
$i$	Suburban rail/metro
$y$	Year of the crediting period

$$TE_{EL,i,y} = EC_{BL,i,y} \times EF_{grid,CM} \times (1 + TDL) \times 10^{-6}$$

Where:

$TE_{EL,i,y}$	Total emissions from suburban rail/metro for year $y$ (tCO <sub>2</sub> )
$EC_{BL,i,y}$	Quantity of electricity consumed by suburban rail/metro in the year $y$ (MWh)
$EF_{grid,CM}$	Emission factor for electricity generation in the grid based on combined margin (gCO <sub>2</sub> /kWh)
$TDL$	Average technical transmission and distribution losses for providing electricity

$$EF_{PKM,i,y} = \frac{EF_{KM,i,y}}{OC_i}$$

Where:

$EF_{PKM,i}$	Emission factor per passenger-kilometre of vehicle category $i$ in the year $y$ (g CO <sub>2</sub> /PKM)
$EF_{KM,i}$	Emission factor per kilometre of vehicle category $i$ in the year $y$ (g CO <sub>2</sub> /km)
$OC_i$	Average occupation rate of vehicle category $i$ prior project start (passengers)
$i$	Relevant vehicle category
$y$	Year of the crediting period

$$OC_B = \frac{PBL_B \times TDBL_{P,B}}{DD_B}$$

Where:

$OC_B$	Average occupation rate of buses prior project start (passengers)
$PBL_B$	Passengers transported by baseline buses prior project (passengers)
$TDBL_{P,B}$	Average trip distance of passengers using baseline bus (kilometre)
$DD_B$	Distance driven by all baseline buses (kilometre)

$$EF_{KM,i,y} = \frac{\sum_x (SFC_{i,x,y} \cdot NCV_{x,y} \cdot EF_{CO2,x,y} \cdot N_{x,i})}{N_i}$$

Where:

$EF_{KM,i,y}$	Emission factor per kilometre of vehicle category $i$ in the year $y$ (gCO <sub>2</sub> /km)
$SFC_{x,i}$	Specific fuel consumption of vehicle category $i$ using fuel type $x$ prior project start (g/km)
$NCV_{x,y}$	Net calorific value of fuel $x$ in the year $y$ (J/g)
$EF_{CO2,x,y}$	Carbon emission factor for fuel type $x$ in the year $y$ (gCO <sub>2</sub> /J)
$N_{x,i}$	Number of vehicles of category $i$ using fuel type $x$ prior to project start (units)
$N_{x,i}$	Number of vehicles of category $i$ prior to project start (units)
$i$	Relevant vehicle category
$x$	Fuel type
$y$	Year of the crediting period

$$EF_{KM,i,y} = (IR_i)^{t+y} \cdot \frac{\sum_x (SFC_{i,x} \cdot NCV_{x,y} \cdot EF_{CO2,x,y} \cdot N_{x,i})}{N_i}$$

Where:

$EF_{KM,i,y}$	Emission factor per kilometre of vehicle category $i$ in the year $y$ (gCO <sub>2</sub> /km)
$SFC_{x,i}$	Specific fuel consumption of vehicle category $i$ using fuel type $x$ prior project start (g/km)
$NCV_{x,y}$	Net calorific value of fuel $x$ in the year $y$ (J/g)
$EF_{CO2,x,y}$	Carbon emission factor for fuel type $x$ in the year $y$ (gCO <sub>2</sub> /J)
$N_{x,i}$	Number of vehicles of category $i$ using fuel type $x$ prior to project start (units)
$N_{x,i}$	Number of vehicles of category $i$ prior to project start (units)
$IR_i^{t+y}$	Technology improvement factor for the vehicle of category $i$ per year $t+y$ (ratio)
$i$	Relevant vehicle category
$x$	Fuel type
$t$	Years of annual improvement (dependent on age of data per vehicle category)

y Year of the crediting period

The following parameters were used for the calculations and were validated by checking thoroughly the mentioned sources and by comparing the different parameters with at least two other CDM-metro-projects (Daegu Metro 3th Urban Railroad, Incheon Metro Line 2) and where appropriate also with Seoul metro line 9 (result see tables below). The main differences were discussed during the on-site visit and could be explained by the PP and other interview partners.

Data / Parameter:	SFC <sub>C</sub> , G/D/LPG	Means of Validation
Data unit:	g/km	
Description:	Specific fuel consumed of passenger cars using gasoline, diesel or LPG	
Source of data used:	Korea Energy Management Corporation. 2010, p.50 (File 63)	[88]
Value applied:	Cars gasoline: 58.46 Cars diesel: 62.60 Cars LPG: 55.91	See below
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on national literature.  To check plausibility the value is compared with: <ul style="list-style-type: none"> <li>- IPCC 1996 (last available source for fuel consumption data vehicles): gasoline cars as lowest US values 11.8 l/100km (table 1-27) and as lowest European value 8.1 l/100km (Table 1-36). The project value of 8.3 l/100km is at the lower end of these values</li> <li>- IPCC 1996 reports for diesel cars as lowest US values 10.0 l/100km (table 1-30) and as lowest European value 7.3 l/100km (Table 1-37). The Korean value is close to the lowest European one (8.1 l/100km)</li> </ul> Gasoline cars represent 68% of vehicles and diesel cars 18% thus being the 2 dominant and most important categories.	Checked with [2] Cars gasoline: 12.1 km/l Cars diesel: 12.38 km/l Cars LPG: 8.73 km/l  Plausibility with IPCC shows that the applied values are conservative
Any comment:	To transform from litres to grams the specific weight of gasoline, diesel and LPG was taken based on IEA, 2005, table A.3.8 Calculation: 3.5.5.1.1 Gasoline: $7.9 \text{ (l/100km)} / 100 * 0.741 \text{ (kg/l)} * 1,000 = 58.46 \text{ g/km}$ 3.5.5.1.2 Diesel: $7.4 \text{ (l/100km)} / 100 * 0.844 \text{ (kg/l)} * 1,000 = 62.60 \text{ g/km}$ LPG: $10.7 \text{ (l/100km)} / 100 * 0.522 \text{ (kg/l)} * 1,000 = 55.91 \text{ g/km}$ The biofuel contents of 2% in diesel is taken as 0-emission for the calculation of CO <sub>2</sub> emissions. The biofuel contents of 2% in diesel is taken as zero-emission for the calculation of CO <sub>2</sub> emissions.	Correct, data crosschecked with specific weights from literature.

Data / Parameter:	N <sub>C</sub> , G/D/LPG	Means of Validation
Data unit:	Vehicles	
Description:	Number of passenger cars using fuel type: gasoline, diesel or LPG	
Source of data used:	File 1, Busan Council Traffic Website, 12/2008	According to methodology, [1]
Value applied:	Gasoline: 612,660 (68%) Diesel: 164,140 (18%) LPG: 124,043 (14%)	Checked with [1]: 67.8%, 18.2%, 13.7%, others 0.2% OK
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official registration statistics	[1], total of 903 484 p-cars OK

Any comment:	This data is monitored annually. Percentages and not absolute figures are required for calculations.	
<b>Data / Parameter:</b>	<b>SFC<sub>M</sub></b>	<b>Means of Validation</b>
Data unit:	g/km	
Description:	Specific fuel consumed of motorcycles	
Source of data used:	File 9, Korea Energy Economics Institute page 407, 423, 04/2009	[9]
Value applied:	38	Checked with [9], → 19.68 km/l
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on national literature. All gasoline	
Any comment:	To transform from litres to grams the specific weight of gasoline was taken based on IEA, 2005, table A.3.8 Calculation: $5.1 \text{ (l/100km)} / 100 * 0.741 \text{ (kg/l)} * 1,000 = 38 \text{ g/km}$	Correct, data crosschecked with specific weights from literature.

<b>Data / Parameter:</b>	<b>SFC<sub>T,LPG</sub></b>	<b>Means of Validation</b>
Data unit:	g/km	
Description:	Specific fuel consumed of LPG taxis	
Source of data used:	File 4a, Korea Energy Economics Institute, 2009, p.391	According to methodology [4]
Value applied:	77	Checked with [4], 6.8 km/l OK
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official statistic	
Any comment:	To transform from litres to grams the specific weight of LPG was taken based on IEA 2005, table A.3.8 Calculation: $\text{LPG: } 14.7 \text{ (l/100km)} / 100 * 0.522 \text{ (kg/l)} * 1,000 = 77 \text{ g/km}$	Correct, data crosschecked with specific weights from literature. OK

<b>Data / Parameter:</b>	<b>N<sub>T,LPG</sub></b>	<b>Means of Validation</b>
Data unit:	Vehicles	
Description:	Number of taxis using LPG	
Source of data used:	File 4a Korea Energy Economics Institute, 2009, p.391	[4]
Value applied:	25,069 (100%)	Checked with [4], OK
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official registration statistics (licensed number including corporation and private units)	Corporation and private taxis
Any comment:	This data is monitored annually. Percentages and not absolute figures are required for calculations.	

<b>Data / Parameter:</b>	<b>SFC<sub>B,D</sub></b>	<b>Means of Validation</b>
Data unit:	g/km	
Description:	Specific fuel consumed of diesel buses	
Source of data used:	Busan Metropolitan City Public Transportation Division, Busan Transportation corporation, 2010 (File 48)	[49] data is not older than 3 years
Value applied:	365	Checked with [49], 2.31 km/l, OK
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on records of total fuel consumed and total distance driven; As total fuel consumed and total distance driven is recorded no separation in bus size is required (latter is required if only SFC data is available to weight SFC per bus size)	Total data according to methodology
Any comment:	To transform from litres to grams the specific weight of diesel was taken based on IEA 2005, Table A.3.8 Calculation: $44\,475,118 \text{ litres} / 102,765,944 \text{ km} * 0.844 \text{ kg/l} *$	Correct, data crosschecked with specific weights from literature. Fuel consumption



	1,000 = 365 The bio-fuel content of 2% in diesel is taken as o-emission for the calculation of CO <sub>2</sub> emissions.	and distances from [49], OK
--	--	-----------------------------

Data / Parameter:	SFC <sub>B,CNG</sub>	Means of Validation
Data unit:	g/km	
Description:	Specific fuel consumed of CNG buses	
Source of data used:	Busan Metropolitan City Public Transportation Division, Busan Transportation corporation, 2010 (File 48)	[49] data is not elder than 3 years
Value applied:	377	Checked with [49], 1.89 km/m <sup>3</sup> , OK
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on records of total fuel consumed and total distance driven; As total fuel consumed and total distance driven is recorded no separation in bus size is required (latter is required if only SFC data is available to weight SFC per bus size)	Total data according to methodology
Any comment:	To transform from m <sup>3</sup> to grams the specific weight of CNG was taken based on molar mass (CH <sub>4</sub> has a molar mass of 16g per mol. 16g/mol * 1000 l/m <sup>3</sup> / 22.4 l/mol = 714g/m <sup>3</sup>  Calculation: 63 166,547 m <sup>3</sup> / 119 641,157 km * 0.714 kg/m <sup>3</sup> * 1 000 = 377	Correct, data crosschecked with specific weights from literature. Fuel consumption and distances from [49], OK

Data / Parameter:	N <sub>B,D/CNG</sub>	Means of Validation
Data unit:	Vehicles	
Description:	Number of diesel and CNG buses	
Source of data used:	Busan Metropolitan City Public Transportation Division, Busan Transportation corporation, 2010 (File 48)	[49] data is not elder than 3 years
Value applied:	Diesel: 1,097 CNG: 1 435	Checked with [49], OK
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on registered units	
Any comment:		

Data / Parameter:	EF <sub>Grid</sub>	Means of Validation
Data unit:	kgCO <sub>2</sub> /kWh	
Description:	Emission factor for the grid	
Source of data used:	KEPCO, 2010 (File 7a/b)	[7] file 7b table EFgrid 2007-2009 OK
Value applied:	0.67379	Checked with [7], OK
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official data; follow procedures as in "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"	According to methodology
Any comment:		

Data / Parameter:	TDL	Means of Validation
Data unit:	---	
Description:	Average technical transmission and distribution losses for providing electricity	
Source of data used:	KEPCO, p. 116 data year 2009 (File 8)	File 8, [8]
Value applied:	1.67%	CL 25 closed; checked with [8], OK
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official value	
Any comment:		

Data / Parameter:	OC <sub>c</sub>	Means of Validation
Data unit:	Passengers	
Description:	Average occupation rate of passenger cars	
Source of data used:	File 3a, Korea Society of Transportation, p.31, 2010	Occupation rates are different for each city. National values should not be used. [3]
Value applied:	1.31	Checked with [3], 1.31 for 2009; this value was used in the PDD as it is more conservative (the emissions per PKM are lower if the occupation rate is higher) than the one from the Korea Transport Institute of 1.3
Justification of the choice of data or description of measurement methods and procedures actually applied :	Survey of independent organization	According to methodology
Any comment:		

Data / Parameter:	OC <sub>t</sub>	Means of Validation
Data unit:	Passengers	
Description:	Average occupation rate of taxis	
Source of data used:	File 5a, Korea Society of Transportation, p.24, 2010	[5], OK
Value applied:	0.83	Checked with [5], based on the average number of occupied passengers multiplied with the average percentage of occupied taxis
Justification of the choice of data or description of measurement methods and procedures actually applied :	Survey of independent organization	
Any comment:	Excluding driver Is monitored also for determination of leakage occupation rate.	

Data / Parameter:	OC <sub>M</sub>	Means of Validation
Data unit:	Passengers	
Description:	Average occupation rate of motorcycles	
Source of data used:	File 10a, South Pacific, 2010	[10], according to methodology, OK
Value applied:	1.04	Checked with [10], OK
Justification of the choice of data or description of measurement methods and procedures actually applied :	Upper 95% confidence level is taken. The sample size required for a 95% confidence level and a 5% maximum error bound of a point estimation of simple random sample is 52 units while the actual sample size taken was 5176 units.	Standard deviation is 0.19 Upper 95% confidence level is conservative
Any comment:		

Data / Parameter:	OC <sub>B</sub>	Means of Validation
Data unit:	Passengers	
Description:	Average occupation rate of buses	
Source of data used:	Busan Metropolitan City Public Transportation Division, Busan Transportation corporation, 2010 (File 15 and 48)	[17], [49],

Value applied:	20 (34%)	See below
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculation based on PKM divided by total distance buses and for percentage average bus capacity	
Any comment:	<p>Is monitored also for determination of leakage occupation rate. Calculation: Passengers: 560 671 025 (File 17, Korea Society of Transportation, 2011) Average trip distance: 7.8 km (File 49, Korea Transportation Safety Authority, 2011 based on average bus speed of 18.3 km/h of and average trip time of 25.5 min) Distance driven buses: 222 407,101 (File 48, Busan Metropolitan City Public Transportation Division, Busan Transportation corporation, 2010)</p> <p>Occupation = <math>\text{PKM} / \text{DD} = 560\,671,025 \text{ passengers} * 7.8 \text{ km} / 222\,407,101 \text{ km} = 20 \text{ passengers}</math></p> <p>Occupation percentage = <math>\text{passengers} / \text{bus capacity} = 20 / 57 = 34\%</math></p> <p>Bus capacity: 57 (File 15, Busan Metropolitan City Public Transportation Division, Busan Transportation Corporation, 2010)</p>	<p>Passengers checked with [17], 1 536 085 daily passengers OK Average trip distance and time checked with [50], 7.78 km OK Distance checked with [49], sum of diesel and CNG OK Bus capacity checked with [15],</p>

Data / Parameter:	PBL <sub>B</sub>	Means of Validation
Data unit:	Passengers	
Description:	Passengers transported by baseline buses per annum	
Source of data used:	File 17, Korea Society of Transportation, 2011	[17]
Value applied:	560 671 025	Passengers checked with [17], see above, OK
Justification of the choice of data or description of measurement methods and procedures actually applied :	Official records; based on average daily numbers multiplied with 365	
Any comment:		

Data / Parameter:	TDBL <sub>P,B</sub>	Means of Validation
Data unit:	Kilometer	
Description:	Average trip distance of passengers using buses prior project start	
Source of data used:	File 49, Korea Transportation Safety Authority, 2011	[50]
Value applied:	7.8	Checked with [50], OK
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on average bus speed 18.3km/h of and average trip time of 25.5min	Checked with [50] (see above) OK
Any comment:		
Any comment:		

Data / Parameter:	DD <sub>B</sub>	Means of Validation
Data unit:	Km	
Description:	Total distance driven by baseline buses per year	
Source of data used:	File 48, Busan Metropolitan City Public Transportation Division, Busan Transportation Corporation, 2010	[49]
Value applied:	222 407 101	Checked with [49], sum of diesel and CNG, OK
Justification of the choice of	Based on CNG distance driven (119 641 157) and diesel	

data or description of measurement methods and procedures actually applied :	distance driven (102 765 944)	
Any comment:		

Data / Parameter:	AD <sub>B</sub>	Means of Validation
Data unit:	Km	
Description:	Average annual distance driven of buses	
Source of data used:	File 48, Busan Metropolitan City Public Transportation Division, Busan Transportation corporation, 2010	[49]
Value applied:	87 839	Checked with [49], OK
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on annual distance driven of all buses of (DD <sub>B</sub> see above) and the number of buses (2 532 units)	Checked with [49], 222 407 101/2532=87'839, OK
Any comment:	Used for leakage load factor change buses if calculation is required. Data is updated if leakage occurs in occupation rate buses with the same source.	

Data / Parameter:	TD <sub>EL,R</sub>	
Data unit:	Km	
Description:	Average trip distance of baseline metro passengers prior project start	
Source of data used:	File 11, BTC, 2011	[11]
Value applied:	9.26	Checked with [11],
Justification of the choice of data or description of measurement methods and procedures actually applied :		
Any comment:		

Data / Parameter:	AD <sub>T</sub>	Means of Validation
Data unit:	Km	
Description:	Average annual distance driven of taxis	
Source of data used:	File 4a, Korea Energy Economics Institute, 2009	[4]
Value applied:	77 561	Checked with [4], average weighted (private and corporate taxis), OK
Justification of the choice of data or description of measurement methods and procedures actually applied :		
Any comment:	Used for leakage load factor change taxis if calculation is required	

Data / Parameter:	NIZ <sub>C,T,BL</sub>	Means of Validation
Data unit:	Vehicles	
Description:	Number of cars/taxis on roads affected per annum in the baseline	
Source of data used:	File 43, Korea Society of Transportation, 2009 Busan Metropolitan Traffic Research Traffic Volume p. 127-128, 2010	[43]
Value applied:	Cars: 14 945 740 Taxis: 3 817 178	Checked with [43] table 18.2-3 daily data multiplied with 360
Justification of the choice of data or description of measurement methods and procedures actually applied :	Continuous measurement on affected road based on average of 2 intersections. Multiplication without expansion factor by 360 for year. Same procedure will be applied during monitoring to ensure consistency.	Monitoring

Any comment:	The same measurements will be realized annually to determine the leakage congestion and speed.	
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Data / Parameter:	V <sub>B</sub>	Means of Validation
Data unit:	Km/h	
Description:	Vehicle baseline speed on affected road	
Source of data used:	File 43, Yusin Corporation, Chungbuk engineering, Hangarim Inc., BTC Line No. 1 Extension Project Feasibility Report, p. 24, 2008	[43]
Value applied:	25	Checked with [43], 25.4 km/h, OK
Justification of the choice of data or description of measurement methods and procedures actually applied :	Moving speed average of both directions	
Any comment:	The average moving speed is measured as this is required for vehicle speed change.	

The further data were checked as follows:

Parameter	Description	Value	Unit	Source	Validation
NCV <sub>G</sub>	Net calorific value gasoline	42.5	MJ/kg	IPCC 2006, table 1.2	Data were checked with appropriate tables in IPCC 2006, OK
NCV <sub>D</sub>	Net calorific value diesel	41.4	MJ/kg	IPCC 2006, table 1.2	
NCV <sub>CNG</sub>	Net calorific value CNG	46.5	MJ/m <sup>3</sup>	IPCC 2006, table 1.2	
NCV <sub>LPG</sub>	Net calorific value LPG	44.8	MJ/kg	IPCC 2006, table 1.2	
EF <sub>CO<sub>2</sub>,G</sub>	CO <sub>2</sub> emission factor gasoline	67.5	gCO <sub>2</sub> /MJ	IPCC 2006, table 1.4	
EF <sub>CO<sub>2</sub>,D</sub>	CO <sub>2</sub> emission factor diesel	72.6	gCO <sub>2</sub> /MJ	IPCC 2006, table 1.4	
EF <sub>CO<sub>2</sub>,CNG</sub>	CO <sub>2</sub> emission factor CNG	54.3	gCO <sub>2</sub> /MJ	IPCC 2006, table 1.4	
EF <sub>CO<sub>2</sub>,LPG</sub>	CO <sub>2</sub> emission factor LPG	61.6	gCO <sub>2</sub> /MJ	IPCC 2006, table 1.4	
EF <sub>CH<sub>4</sub>,CNG</sub>	CH <sub>4</sub> emission factor of CNG buses	162.0	gCO <sub>2</sub> /km	IPCC 2006, table 3.2.4	
EF <sub>CH<sub>4</sub>,LPG</sub>	CH <sub>4</sub> emission factor of LPG light vehicles	0.5	gCO <sub>2</sub> /km	IPCC 2006, table 3.2.4	
	Specific weight gasoline	0.741	kg/l	IEA, 2005, table A.3.8	Data were checked with literature, OK
	Specific weight diesel	0.844	kg/l	IEA, 2005, table A.3.8	
	Specific weight CNG	0.714	kg/m <sup>3</sup>	Based on molar mass	
	Specific weight LPG	0.522	kg/l	IEA, 2005, table A.3.8	
IR	Technology improvement factor	0.99	no unit	ACM0016	According to methodology

The validation team checked the calculations in the Excel file "PDD tables Metro Busan vs 17/10/2012.xls" [89] table baseline emissions with above assumptions and states that the calculations were done according the methodology and that the results for baseline emissions are reliable.

## PROJECT EMISSIONS

Project emissions were calculated according to the following formulas

$$PE_y = DPE_y + IPE_y$$

Where:

$PE_y$  Project emissions in the year  $y$  (tCO<sub>2</sub>)  
 $DPE_y$  Direct project emissions in the year  $y$  (tCO<sub>2</sub>)  
 $IPE_y$  Indirect project emissions in the year  $y$  (tCO<sub>2</sub>)  
 $y$  Year of the crediting period

$$DPE_y = EC_{PJ,y} \times EF_{grid,CM} \times (1 + TDL) \times 10^{-6}$$

Where:

$DPE_y$  Direct project emissions in the year  $y$  (tCO<sub>2</sub>)  
 $EC_{PJ,y}$  Quantity of electricity consumed by project metro for traction in the year  $y$  (MWh)  
 $EF_{grid,CM}$  Emission factor for electricity generation in the grid based on combined margin (gCO<sub>2</sub>/kWh)  
 $TDL$  Average technical transmission and distribution losses for providing electricity

$$IPE_y = \frac{P_y}{P_{SPER}} \sum_p (IPE_{p,y} \cdot FEX_{p,y})$$

Where:

$IPE_y$  Indirect project emissions in the year  $y$  (g CO<sub>2</sub>)  
 $IPE_{p,y}$  Indirect project emissions per surveyed passenger  $p$  in the year  $y$  (g CO<sub>2</sub>)  
 $FEX_{p,y}$  Expansion factor for each surveyed passenger  $p$  surveyed in the year  $y$  (each surveyed passenger has a different expansion factor)  
 $P_y$  Total number of passengers in the year  $y$   
 $P_{SPER}$  Number of passengers in the time period of the survey (1 week)  
 $p$  Surveyed passenger  
 $y$  Year of the crediting period

$$IPE_{p,y} = \sum_i IPTD_{p,i,y} \times EF_{PKM,i,y}$$

Where:

$IPE_{p,y}$  Indirect project emissions per surveyed passenger  $p$  in the year  $y$  (g CO<sub>2</sub>)  
 $BTD_{p,i,y}$  Indirect project trip distance  $p$  per surveyed passenger using mode  $i$  in the year  $y$  (PKM)  
 $EF_{PKM,i,y}$  Emission factor per passenger-kilometre of mode  $i$  in the year  $y$  (g CO<sub>2</sub>/PKM)  
 $i$  Relevant vehicle category  
 $p$  Surveyed passenger  
 $y$  Year of the crediting period

The following data were used:

Data / Parameter:	EC <sub>PJ</sub>	Means of Validation
Data unit:	MWh	
Description:	Electricity consumed by project metro	
Source of data to be used:	BTC	According to methodology

Value of data applied for the purpose of calculating expected emission reductions in Section B.5	<p><b>Table 14: Electricity Consumption per Year (MWh)</b></p> <table><tr><th>2014</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th></tr><tr><td>10,025</td><td>10,118</td><td>10,212</td><td>10,283</td><td>10,335</td><td>10,427</td><td>10,500</td></tr></table> <p>For projections based on operating lines train electricity consumption per passenger</p>	2014	2015	2016	2017	2018	2019	2020	10,025	10,118	10,212	10,283	10,335	10,427	10,500	CL 28, data checked with [11], OK
2014	2015	2016	2017	2018	2019	2020										
10,025	10,118	10,212	10,283	10,335	10,427	10,500										
Description of measurement methods and procedures to be applied:	<p>Traction energy only</p> <p>Monitoring frequency: Continuously, aggregated at least annually</p> <p>There are two substation converters for the station which include the shops and station office electricity (AC), and traction electricity (DC). The transformer converts 22.9 kV to 1500 DC for traction energy. The measurement of DC1500V for the train is checked in the rectifier which includes the watt-hour meter of BTC. Total electricity consumed is registered by KEPCO which owns and calibrates the meters. Traction energy is only recorded by BTC. The DTRO equipment is not calibrated since it is attached in the rectifier (see for details Section B.7.2.).</p>	See monitoring														
QA/QC procedures to be applied:	<p>Control with electricity invoices. The electricity meters are calibrated by the local electricity board. The electricity meters are not owned or managed by BTCbut by KEPCO. Latter is also responsible for their periodic calibration. Electricity meters are calibrated, depending on the electricity meter type, every 7 to 15 years based on regulations of the Ministry of Knowledge Economy (File 59).</p>	See monitoring														
Any comment:	<p>Used to calculate together with the emission factor grid the DPE as per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”.</p>	According to methodology														

Other parameters used for *ex-ante* calculation were checked as follows:

Parameter	Description	Value	Unit	Source	Validation
EF <sub>grid,CM</sub>	Emission factor of grid	0.67379	tCO <sub>2</sub> /MWh	File 7	[7], see above OK
TDL	Average technical transmission and distribution losses for providing electricity	1.67%	percentage	File 8 [8]	CL 25, answer = average over 1 year [8], see above OK
EF <sub>PKM,i</sub>	Emission factor per passenger-kilometer of mode "i"	See table A4	gCO <sub>2</sub> /PKM		See baseline calculation OK
IP <sub>TDPS,i</sub>	Indirect project trip distance of the surveyed passenger using mode "i"	Value per passenger surveyed	km		CL 27, value for ex-ante calculation checked with [76, survey], OK
P	Passengers transported by the project	See table A5	passengers	File 14	CL 30 Checked with [72] see text below, OK

**Table A4. Emissions per Passenger-Kilometre of Modes (gCO<sub>2</sub>/PKM)**

Mode	2014	2015	2016	2017	2018	2019	2020
Passenger car	123	121	120	119	118	117	115
Taxi	243	241	239	236	234	231	229
Bus	54	54	53	53	52	52	51
Motorcycle	98	97	96	95	94	93	92
Existing metro	44	44	44	44	44	44	44

**Table A5. Baseline Emissions**

Parameter	unit	2014	2015	2016	2017	2018	2019	2020
Number of passengers	passengers	16,831,730	16,988,378	17,145,026	17,265,041	17,385,896	17,507,598	17,630,151
Average baseline emission factor	gCO <sub>2</sub> /passenger	1,150	1,139	1,127	1,116	1,105	1,094	1,083
<b>Total baseline emissions</b>	<b>tCO<sub>2</sub></b>	<b>19,358</b>	<b>19,343</b>	<b>19,326</b>	<b>19,267</b>	<b>19,208</b>	<b>19,149</b>	<b>19,090</b>

EF<sub>Grid</sub> was calculated in the PDD according to the “Tool to calculate the emission factor for an electricity system”, v1”, which is still valid for this validation [81]; it is described in detail in Annex A7 “Determination of the combined margin”. Step 1 asks for the identification of the relevant electricity system, where the national grid of the Republic of Korea was chosen. In step 2 only grid power plants were included. In step 3 the simple OM (operating margin) was chosen, since less than 50% of the total grid are low-cost/must run resources. In step 4 the OM was calculated with option A, because the data on fuel consumption and electricity generation is available by power unit in Korea; a value of 0.7366 tCO<sub>2</sub>/MWh came out. In step 5 the build margin emission factor was calculated with option 1 (*ex-ante*); a value of 0.6610 tCO<sub>2</sub>/MWh resulted. And finally, in step 6 the combined margin emission factor was calculated with the default weight factor of 0.5, resulting in 0.6738 tCO<sub>2</sub>/MWh.

All sources ([6], [7], [8]) were carefully checked by SQS and the results were compared with the data in 20120601\_iges\_er\_sheet\_gridf\_EN.xls [85]; the result of 0.6738 tCO<sub>2</sub>/MWh was thus calculated according the appropriate tools and is reasonable.

It was not clear how the electricity consumption ex-ante of the project EC<sub>PJ,y</sub> was estimated, and therefore CL 28 was raised. The calculation is based on the existing line 1, where a value of around 0.6 kWh per passenger resulted. CL 28 could be closed.

The baseline and indirect project emissions are based on a pilot survey of some 700 samples realized on the existing metro line on 01/10/2010 using the same questionnaire as will be used by the project metro (CL 27). As the project metro line is not yet operational, no survey on the project line itself could be conducted. However, it is considered as the best possible approximation making a survey on the metro line 1 (the project itself is an extension of this line) although modes used as well as trip distances can of course vary in relation to the project metro line. However, the pilot survey is only used for projection purposes and actual ERs will be based on the project surveys conducted on the project line once operational.

The passenger survey was validated by verifying a random sample of 30 original documents of the survey, which gave a good conformity (see CL 26). It was done by the local expert using the website “naver.com”.

The statistics as foreseen in the methodology on page 40 for the passenger survey was not done in the PDD and could therefore not be controlled. This is understandable since the survey does not correspond to the real project, which is not yet running. The survey is used just for the ex-ante estimation of the emission factor per passenger-kilometres and thus for the emission reductions; a detailed statistical analysis would make no sense, because the survey could not be done on the new extension of line 1. Furthermore, the expansion factors were not considered as applicable since they will change with the real survey, which will be done after the start of the new extension line 1.

CL 30 was raised regarding the passenger numbers. They come from the feasibility study: However, it was not clear on which base the data were estimated.

The answer by the project proponent stated that the passenger numbers were deducted from those already known from the operation of the metro line 1. However, there is still some uncertainty because the passenger numbers for the calculation of revenues and project emissions are slightly different. The answer by the PP resulted in an adaption of passenger numbers P; File 37c [72] is part of the feasibility report and was used for the estimation of passenger numbers until 2020. It consists of numbers for the low and for the high season based on the existing passenger numbers for line 1. The new data are around 7.5% lower than initial, which gave about the same relative difference in emission reductions. CL 30 could be closed, since the data source is



now clear and consistent.

CL 37 was raised because it was not clear how the check of internal consistency of the survey (using Cronbachs Alpha) will be performed. The answer shows the explanation according to the methodology; since there is currently no need to apply the survey statistics according to the methodology, CL37 could be closed.

All calculations were controlled with the “PDD tables Metro Busan” [89], the requirements by the methodology like the adaption of the technology improvement factor or the 95% confidence level as given in the methodology were checked.

The validator controlled all formula for baseline/project/leakage emissions and confirms that all are in accordance with the approved methodology. All data has been inserted appropriately and all calculations have been performed correctly. This was controlled by the validator through the “PDD tables Metro Busan” [89] provided by the PP which includes all parameters, all values, all formulas and performs all calculations. All estimates of the baseline and project emissions can be replicated using the data and parameter values provided in the PDD.

The sensitivity analysis is given in Annex 3, A.5 Table A11: It shows that the only three sensitive parameters are the number of project passengers, the electricity consumption of the metro and the occupation rate of passenger cars:

#### Sensitivity Analysis

Parameter	% Change required for 5% less ERs	Sensitive or Not	Comment
Project passengers	5% less passengers	Sensitive	Data is monitored continuously and checked with ticket sales. Core data for project owner and thus also adequate monitoring of latter. Fare dodgers are not counted thus understating also potentially passenger numbers.
Metro electricity consumption	8% increase	Sensitive	Data is monitored continuously.
Specific fuel consumption gasoline cars	>10% lower fuel consumption	Not sensitive	
Specific fuel consumption diesel cars	> 10% lower fuel consumption	Not sensitive	
Specific fuel consumption LPG cars	> 10% lower fuel consumption	Not sensitive	
Specific fuel consumption taxis	10% lower fuel consumption	Not sensitive	
Specific fuel consumption motorcycles	10% lower fuel consumption	Not sensitive	
Specific fuel consumption diesel buses	> 10% lower fuel consumption	Not sensitive	
Specific fuel consumption CNG buses	> 10% lower fuel consumption	Not sensitive	
Passengers buses	> 10% more passengers	Not sensitive	
Trip distance passengers buses	> 10%	Not sensitive	

	longer trip		
Passengers existing metro	> 10% more passengers	Not sensitive	
Electricity consumption existing metro	> 10% less consumption	Not sensitive	
Average trip distance existing metro	> 10% longer trip	Not sensitive	
Occupation rate passenger cars	8% higher occupation rate	Sensitive	Survey of independent organization; Other Korean cities are in the same range with Seoul 1.25, Incheon 1.25 and Daegu 1.21 (File 53)
Occupation rate taxis	>10% higher occupation rate	Not sensitive	
Occupation rate motorcycles	>10% higher occupation rate	Not sensitive	

The project owner has detailed the results of the sensitivity analysis in Annex 3 Section A5 of the PDD. The sensitivity results are obtained by changing one specific parameter. This is technically done by using the CER spread-sheet. Changing one specific parameter of this spread-sheet e.g. SFC passenger cars by x will result automatically in a change of the ER result. The PP has thereby calculated for each parameter the reduction percentage required to change the total ERs over the crediting period by 5% (ACM0016 states "The sensitivity analysis is based on calculating the change of the data parameter that would be required to reduce emission reductions by 5%"). Based on ACM0016: "Assess the result in light of possible data uncertainty. As sensitive parameter/data are considered those where a change of less than 10% leads to a reduction of ERs of more than 5%."

The validation team has checked for various random parameters including all critical parameters, the calculations made with the same spreadsheet inserting the percentage change as indicated in the PDD and revising the ER outcome. The excel sheet "PDD tables Metro Busan" [89] is fully interlinked i.e. any parameter change automatically results in corresponding ER changes. SQS agrees with the result in the PDD. The occupation rate of passenger cars is the highest of all the mentioned cities (Seoul, Incheon, Daegu). If one takes instead of 1.31 passengers/per car the one for Daegu (1.21), then the emission reduction rises by 6%; the value of 1.31 is therefore rather conservative.

## LEAKAGE EMISSIONS

The leakage emissions will be calculated according to the following formulas:

$$LE_y = LE_{LFB,y} + LE_{LFT,y} + LE_{CON,y}$$

Where:

$LE_y$	Leakage emissions in the year y (tCO <sub>2</sub> )
$LE_{LFB,y}$	Leakage emissions due to change of load factor buses in the year y (tCO <sub>2</sub> )
$LE_{LFT,y}$	Leakage emissions due to change of load factor taxis in the year y (tCO <sub>2</sub> )
$LE_{CON,y}$	Leakage emissions due to reduced congestion in the year y (tCO <sub>2</sub> )
y	Year of the crediting period

If  $LE_y < 0$ , then leakage is not included

If  $LE_y > 0$ , then leakage is included

$$LE_{LFB,y} = \frac{1}{10^6} \cdot N_{B,y} \cdot AD_B \cdot EF_{KM,B,y} \cdot \left(1 - \frac{OC_{B,y}}{OC_B}\right)$$

Where:

$LE_{LFB,y}$	Leakage emissions due to change of load factor of buses in the year y (tCO <sub>2</sub> )
$N_{B,y}$	Number of baseline buses in the year y (buses)
$AD_B$	Average annual distance driven by baseline buses (km/bus)
$EF_{KM,B,y}$	Emission factor per kilometre of baseline buses in the year y (g CO <sub>2</sub> /km)
$OC_{B,y}$	Average occupancy rate of baseline buses in the year y (passengers)
$OC_B$	Average occupancy rate of baseline buses prior project start (passengers)
y	Year of the crediting period

$$LE_{LFT,y} = N_{T,y} \cdot AD_T \cdot EF_{KM,T,y} \cdot \left(1 - \frac{OC_{T,y}}{OC_T}\right) \cdot \frac{1}{10^6}$$

Where:

$LE_{LFT,y}$	Leakage emissions due to change of load factor of taxis in the year y (tCO <sub>2</sub> )
$N_{T,y}$	Number of taxis in the year y (taxis)
$AD_T$	Average annual distance driven per taxi (km/taxi)
$EF_{KM,T,y}$	Emission factor per kilometre of taxis in the year y (g CO <sub>2</sub> /km)
$OC_{T,y}$	Average occupancy rate of taxis in the year y (passengers)
$OC_T$	Average baseline occupancy rate of taxis prior project start (passengers)
y	Year of the crediting period

$$LE_{CON,y} = LE_{REB,y} + LE_{SP,y}$$

Where:

$LE_{CON,y}$	Leakage emissions due to reduced congestion in the year y (tCO <sub>2</sub> )
$LE_{REB,y}$	Leakage emissions due to induced traffic / rebound effect in the year y (tCO <sub>2</sub> )
$LE_{SP,y}$	Leakage emissions due to changing vehicle speed in the year y (tCO <sub>2</sub> )

$$LE_{REB,y} = \frac{1}{10^6} \cdot \sum_i (TDIZ_{i,y} \cdot EF_{KM,i,y} \cdot (NIZ_{i,y} - NIZ_{i,BL} + NIZ_{i,MS,y}))$$

Where:

$LE_{REB,y}$	Leakage emissions due to rebound effect in the year y (tCO <sub>2</sub> )
$NIZ_{i,y}$	Number of cars/taxis per annum using the affected roads in the year y (cars, taxis)
$NIZ_{i,BL}$	Number of cars/taxis per annum using the affected roads in the baseline (cars, taxis)
$NIZ_{i,MS,y}$	Number of cars/taxis per annum not used anymore due to mode shift to the MRTS in the year y (cars, taxis)
$TDIZ_i$	Average trip distance made by cars/taxis on the affected roads in the year y (km)
$EF_{KM,i,y}$	Emission factor per kilometre of cars and taxis in the year y (g CO <sub>2</sub> /km)
i	Cars, taxis
y	Year of the crediting period

$$NIZ_{i,MS,y} = \frac{MS_{i,s} \cdot P_y}{OC_i}$$

Where:

$NIZ_{i,MS,y}$	Number of cars/taxis per annum not used anymore due to mode shift to the metro in the year $y$ (cars, taxis)
$MS_{i,y}$	Net share of passengers using the metro which would have used mode $i$ in the year $y$ (%)
$P_y$	Passengers transported by the project in the year $y$ (passengers)
$OC_i$	Average occupation rate of vehicle category $i$ prior project start (passengers)
$i$	Cars, taxis
$y$	Year of the crediting period

$$LE_{SP,y} = \frac{1}{10^6} \cdot \sum_i (NIZ_{i,y} \cdot TDIZ_{i,y} \cdot (EF_{KM,VP,i,y} - EF_{KM,VB,i}))$$

Where:

$LE_{SP,y}$	Leakage emissions due to changes in vehicle speed of cars and taxis in year $y$ (tCO <sub>2</sub> )
$NIZ_{i,y}$	Number of cars/taxis using the affected roads in the year $y$ (cars, taxis)
$TDIZ_{i,y}$	Average trip distance made by cars/taxis on the affected roads in the year $y$ (km)
$EF_{KM,VP,i,y}$	Emission factor per kilometre of cars/taxis at project speed in the year $y$ (g CO <sub>2</sub> /km)
$EF_{KM,VB,i}$	Emission factor per kilometre of cars/taxis at baseline speed (g CO <sub>2</sub> /km)
$i$	Cars, taxis
$y$	Year of the crediting period

The following data will be used:

Parameter	Description	Value	Unit	Source	Validation
$AD_B$	Average distance driven by buses per annum	87 839	kilometer	File 48	Checked with [49] OK
$OC_B$	Occupation rate buses baseline	34%	%	File 17 48 49	Checked with [15], [17], [49], [50], see above under baseline 3.5.4., OK
$AD_T$	Average distance driven by taxis per annum	77 561	kilometer	File 4	[4], see above, OK
$NIZ_{i,BL}$	Number of cars/taxis using affected roads in the baseline	see table below	vehicles	File 43	See below, [43], OK
$V_{BL}$	Baseline speed of vehicles on affected roads (moving speed)	see table below	km/h	File 43	See below, [43], OK

Affected Road	Number of cars	Number of taxis	Average moving speed	Average total speed	Validation
Dadae-ro	14 945 740	3 817 178	25	25	Site visit and checked with [43] sheet 18.2-3, OK

For the leakage calculation the procedures in the methodology are followed and the appropriate parameters are measured and defined (see also 3.7 Monitoring Plan). They were controlled by SQS through checking the mentioned sources. The affected road was visited by the two auditors on 06/02/2012. There is no other road affected. For the *ex-ante* calculation no leakage was adopted.

As a summary, the validation team concludes that the Excel file "PDD tables metro Busan vs. 17.10. 2012" [89] was checked extensively for correct input values, formulas, and crosschecked for consistency with the

referenced documents. No errors were found after the corrections had been made.

SQS concludes that the parameters and the mathematical operations used for the *ex-ante* estimation of the project's emission reductions are correct, reasonable and conservative. All estimates of the baseline emissions can be replicated using the data and parameter values provided in the PDD. Of course the *ex-ante* calculations are an estimate, which could lead to differences when the metro is operating and the real survey will be done.

No.:	CL 25	Reference: PDD B.6.2 p.44
Validator request:	It is not clear, why the value for the TDL (1.67%) was chosen just only from 1 year (and not 3 years as the grid emission factor).	
Project owner response:	The grid emission factor is based on how to calculate the CM, which is based on a 3-year average of the OM (not the BM). This is irrelevant for TDL. TDL is based on the most recent available year. This is in accordance with the EB Tool to calculate baseline, project and/or leakage emissions from electricity consumption section "Data and Parameters Monitored" which also states annual data (annual monitoring)	
Validator conclusion:	OK, explanation accepted, CL 25 closed	Date: 28/04/2012

No.:	CL 26	Reference: PDD B.6.3 and Table A1
Validator request:	Please send the following samples out of the survey together with a translation pattern to the validator: 2, 10, 102, 121, 130, 197, 202, 221, 230, 302, 321, 330, 369, 402, 404, 421, 421, 430, 502, 504, 521, 530, 542, 602, 604, 621, 630, 702, 704, 730	
Project owner response:	See file survey translation and file surveys scanned	
Validator conclusion:	The samples were reviewed by the local expert and are correct. CL 26 closed	Date: 28/04/2012

No.:	CL 27	Reference: PDD B.6.3 and Annex 3
Validator request:	The description and source of the test survey (PDD tables) are not or not mentioned clearly enough (e.g. Table A1)	
Project owner response:	Annex 3 details have been added. Section B.6.3. is not related to the survey	
Validator conclusion:	The explanation has been added. CL 27 closed	Date: 28/04/2012

No.:	CL 28	Reference: PDD p. 52, Table 14
Validator request:	It is not clear, how the electricity consumption ex-ante of the project was estimated.	
Project owner response:	The project is an extension of an operating metro line. The projections have therefore been based on the operating lines train electricity consumption per passenger as explained in B.6.2.	
Validator conclusion:	Explanation OK. CL 28 closed	Date: clearly enough

No.:	CL 30	Reference: PDD B 6.3 and Annex 3 Table A5
Validator request:	Passenger numbers for the extension come from the feasibility study. However, it is not clear how these passenger numbers were estimated and if they are conservative.	
Project owner response:	See File 37c.	
Validator conclusion:	There is a slight difference between passengers used for calculating revenues (file 37c) and the passengers in File 14 used for calculating emission reductions, why? It is still not clear on which base the passenger numbers in the feasibility study were estimated.	
		Date: 28/04/2012

Project owner response:	File 14 is based on daily date while File 37c has differentiated daily data between peak and off-peak season and has then multiplied with a factor for peak and off-peak. In the FSR of File 14 this differentiation is not made. The demand estimation is based on the existing line. The project is only an extension of a metro line and thus demand estimates are based primarily on the existing line and origin-destination surveys of passengers using the metro line 1.
Validator conclusion:	The answer for the difference between File 14 and File 37c is correct, but it does not explain why two different numbers are used for income- and reduction-calculations. The explanation for the feasibility study is clear. Date: 29/04/2012
Project owner response:	File 14 had been calculated by the PD. File 37c data has been taken for passenger estimates per annum and the PDD as well as CER sheet have been adapted. See also new files 37c and 14 Date: 30/04/2012
Validator conclusion:	Adaption of PDD [75] and PDD tables Busan [76], which resulted in around 7.5% lower emission reductions. New files 37c [72] and 14 [71]. CL 30 closed Date: 02/05/2012

No.:	CL 37	Reference: PDD B.7.1 and Annex 4 and monitoring manual
Validator request:	It is not clear how the check of internal consistency of the survey (using Cronbachs Alpha) will be performed. Specifically, it is not clear which items will be chosen for the calculation of the sub-variances.	
Project owner response:	Cronbach is used to test the consistency of results between the 2 measurements in different times as proxy regarding the internal consistency of the survey. The consistency is checked within the same unit of analysis, which corresponds to the metro station. The average emissions per metro station are checked between the 2 surveys. If the emission levels of the same station between the two measurements are highly correlated this implies the correlation and consistency of the main items of the survey with latter being modes of transit and distance per mode.	
Validator conclusion:	The explanation is correct and will be adapted for the verification surveys. CL 37 closed.	Date: 28/04/2012

### 3.6 Additionality of project activity

The additionality of the project was determined using the "Tool for the demonstration and assessment of additionality, v05.2.1". This tool is still valid and is appropriate to demonstrate additionality.

#### 3.6.1 Prior consideration of the clean development mechanism

The project starting date is the construction start date of the contract with the Hyundai Construction Company being 04/11/2009. The appropriate document is scanned and translated in File 25a and b [25] and could be verified on-site by the local expert.

Since according to EB62 Annex 13 "Guidelines on the demonstration and assessment of prior consideration of CDM (version 4)" this is a new project activity (project starting date after 02/08/2008) the DNA and the UNFCCC must be informed within 6 months of the project starting date. The notification for UNFCCC could be checked on

the appropriate internet site (02/12/2009) ([http://cdm.unfccc.int/Projects/PriorCDM/notifications/index\\_html](http://cdm.unfccc.int/Projects/PriorCDM/notifications/index_html)), the one for the Korean DNA was written on the standardized form F-CDM-Prior Consideration and submitted on 30/11/2009, which is less than 6 months after the project start. CL15 was raised because there was no acknowledgement document from the DNA. The acknowledgement document was sent and translated in file 16 [16]; CL15 could be closed.

The official stamps on the mentioned letters give, according to the local expert, proof that the documents were issued by the mentioned official sites.

No.:	CL 15	Reference:	PDD B.5 prior consideration
Validator request:	The acknowledgment of the prior consideration form by the Korean DNA is documented with a respective letter of 2011. The dates there and in the PDD and in the form are not the same everywhere; the letter is not a listed document.		
Project owner response:	See File 61 which has also been referenced in PDD		
Validator conclusion:	The amendment of the PDD is OK. There are still several confusing dates regarding prior consideration: Submission date in the PDD is 02/12/2009, submission date in the prior consideration form (File 33) [33] is 30/11/2009; the acknowledgement by the DNA (File 61) shows a document date of 16/12/2009, a date in the Korean text again of 16/12/2009 with a number of 2463, a date in the translation of 03/12/2009 and a corresponding number of 2365. Please explain. Date: 27/04/2012		
Project owner response:	File 31: The date in the UNFCCC template is filled out by the PP (30.11.2009) and thus not the relevant proof date. The relevant proof date used in the PDD is the one as published on the UNFCCC website as document received: <a href="http://cdm.unfccc.int/Projects/PriorCDM/notifications/index_html">http://cdm.unfccc.int/Projects/PriorCDM/notifications/index_html</a> This date is 02/12/2009 File 61: has as date 16/12/2009 (date of confirmation of reception of document). The translation was wrong and has been corrected (see new file 61). The PDD for reception of the Korean DNA of prior consideration has also been changed to the date 16/12/2009.		
Validator conclusion:	Explanation and amendment of	Date:	28/04/2012
	File 61 [62] OK. CL 15 closed.		

### 3.6.2 Identification of alternatives

The list of alternatives is discussed in Chapters B4 and B5 of the PDD. SQS' opinion on Chapter B4 of the PDD is given in clause 3.5.4 of this validation report.

In chapter B5 of the PDD the following alternatives are listed:

1. The establishment of a BRT (Bus Rapid Transit);
2. The establishment of another rail-based MRTS;
3. The continuation of the current public and individual transport systems, including (future) investments in road based infrastructure if applicable;
4. The proposed project activity being implemented at a later date in the future, without being registered as a CDM project activity;
5. The project proposal not implemented as a CDM project activity.

Alternatives 1 and 2 are assessed in Chapter B.4. of the PDD and have been discarded:

Alternative 1: Busan has already established 4 metro lines. Also the project is an extension of a metro line and thus it makes technically no sense to establish a different system i.e. passengers would need to change from underground metro to a BRT for travelling the last stations which would not be convenient. Also BRTs due to their limited phd capacity are also basically used for secondary lines in large metropolitan cities in which a rail-based MRTS have already been established. Also with Incheon already having a metro line the connectivity is easier if the same system can be used and buses are thereafter used for secondary routes. For the area in which the metro is planned a BRT system is also considered as non-optimal basically due to the required passenger per hour capacity. BRT or bus lane systems have typical carrying capacities of less than 10,000

passengers per hour per direction (phd) (proven in Table 4 of the PDD). The median value for all included BRTs is 7,000 phd which gives an indication that BRT are basically used for secondary lines in large metropolitan cities and as main lines in smaller and medium sized cities. Also the only operational Korean BRT in Seoul has a capacity of 7,000 passengers per hour and direction only. The capacity of the proposed metro line is for up to 49,000 passengers per hour per direction.

Alternative 2: The project is an extension of a metro line and thus it makes no technical sense for a 8 km stretch to use a different rail-based system.

Alternative 3 is the baseline situation.

Alternative 4 has been discarded in Chapter B4 respectively is identical with the alternative 5.

Following alternatives are thus credible, realistic and comparable:

1. Continuation of the current situation
2. Project without CDM

The options BRT, other rail-systems and the option project in the future without CDM are not considered credible, realistic or comparable alternatives as outlined in Chapter B.4. of the PDD. They are thus eliminated in Step 1 and not further considered. Step 2 conducts an investment comparison analysis for all alternatives that are **remaining** after Step 1 in accordance with page 6 of ACM0016:

“Apply Step 2 of the latest approved version of the “Tool for the demonstration and assessment of additionality”. Conduct an investment comparison analysis for all alternatives that are remaining after Step 1. Use the NPV as indicator.”

Step 1 is performed in B.4. of the PDD and Chapter B.5. then resumes the result of Chapter B.4. As only 1 alternative to the baseline remains after step 1 only for this alternative the financial analysis is performed.

SQS agrees that identified alternative 3 “Continuation of the current system incl. future investments” is correctly determined as the baseline scenario.

### 3.6.3 Investment analysis

The investment analysis is required by the methodology ACM0016: “Conduct an investment comparison analysis for all alternatives that are remaining after Step 1. Use the NPV as indicator.” The two remaining alternatives after step 1 are (see 3.5.4)

1. Continuation of the current situation
2. Project without CDM

The guidelines for the investment analysis version 5 EB62 Annex 5 were followed. The following table shows the principles, the adoption for the project and the means of validation.

EB Guideline	Project	Validation
Points 1 and 2: General introduction of Guidance		
Point 3: Period of assessment	The period of assessment taken is 30 years of operation plus the construction period in line with the assessment made in the FSR by Yusin Corporation, Chungduk Engineering, Hangaram, 2008 (File 36). This is a longer period than the maximum period suggested in the guidelines and thus conservative.	The guidelines suggest a maximum period of 20 years. SQS agrees that 30 years is more conservative. OK
Point 4: Salvage value	No salvage value is included for equipment and rolling stock as this is considered the technical life span in line with other metros. Construction and stations can have a longer time period but also need repairs and overhauls. The full land value is included as salvage value. Overall this is more conservative as the FSR, which includes some additional investments for rolling stock, equipment and construction during the 30-year operation period.	CAR1 and CL20 were raised regarding the salvage value and the land costs. The explanation for the salvage value is correct, the land costs are fully included as salvage. The expenditures for land



		was planned to be in 2006-2008, but a document of Feb 2012 showed that in fact it was spent later after the beginning of the construction. OK
Point 5: Depreciation and other non-cash items	The NPV is based on cash flow and does not include depreciation or other non-cash items.	OK
Point 6: Time of assessment	All calculations are based on the FSR report realized by Yusin Corporation, Chungbuk Engineering, Hangaram, 2008 (File 36) in 8/2008 prior to the investment decision 09/2009 which again is prior to the project starting date of 04/11/2009	The base year of the mentioned report is 2007, which is prior to the investment decision of 09/2009. OK
Point 7: Cessation of implementation	Not relevant for project	OK
Point 8: Provision of spreadsheet	Spreadsheet is provided (File 34)	CL17, CL18, CL19, see text below. OK
Point 9: Finance expenditures	Financing expenditures are not included when calculating the NPV.	OK
Point 10: Equity IRR	Not used by project as ACM0016 requires the usage of NPV.	According to methodology, OK
Point 11: Pre-tax benchmark	The project uses NPV with a benchmark of 0%, which is lower than the benchmark used by the FSR table 8-11 (File 36) being 5.5% due to the fact that no profit is targeted.	Correct and conservative OK
Point 12-18: Selection of benchmark	ACM0016 explicitly asks for a NPV. The financial/economic indicator chosen is thus the NPV in accordance with the methodology. The discount rate taken is 0% and thus very conservative.	Correct and conservative OK
Point 19: Benchmark analysis	Analysis is made based on NPV as required by ACM0016	According to methodology, OK
Points 20 and 21: Sensitivity analysis	<p>Sensitivity analysis is made assuming following changes:</p> <ul style="list-style-type: none"> <li>• 10% lower investment costs</li> <li>• 10% lower operational cost</li> <li>• 10% increase in fare box revenues</li> <li>• Break-even point (0 NPV) with changing risk parameter</li> </ul> <p>These are all important cost/revenue variables and all variables, which constitute more than 20% of, cost respectively revenue.</p>	The sensitivity analysis shows always a negative NPV. For NPV = 0 the risk factor has to be increased by around 15% above 1. SQS agrees that this is not realistic. OK

One CAR (CAR 1) and three CLs (CL 17, CL 18, CL 19) were raised regarding the financial analysis: CAR 1 was raised since it was not fully clear if the full salvage value was included in the financial calculations. The answer was yes and could be checked in the financial File 34 [34]. Thus, CAR 1 could be closed. CL 17 asked for more details about the operational costs and CL 18 and CL 19 asked for more information about fare-box revenues and the ticket prices.

The **investment cost** of 720 100 million WON is equivalent to around 74 million USD per km of track (exchange rate 09/2009). This cost was checked with two sources: IEA estimates initial capital costs for underground MRTS between 60-180 million USD/km (Bussystem for the future p.29 [47]) with the project metro being in the lower range. Another study published in the year 2008 comparing the capital costs of urban rail per kilometer came to costs of 50-150 million USD per km mainly for European Metros [48], which again covers the investment cost of 74 million USD per km.

The investment cost is based on Yusin Corporation, Chungbuk Engineering, an independent 3<sup>rd</sup> Party. To assess the plausibility of the value independent and well known international sources are taken being the IEA and a published report by B Flyvbjerg, Comparison of Capital Costs per Route-Kilometre in Urban Rail, EJTIR, 8, no. 1 (2008) which show that the investment cost of the project with 74 million USD/km (underground metro) is at the lower end of international estimates. The Article of Flyvbjerg includes thereby also the investment cost

of Seoul metro network (117km) which is stated to be 65.8 million USD/km in 2002 (Table 3, p.23; this includes not only underground stretches; underground metro is more expensive than elevated or at-level, see IEA source). The most complete and comparable metro network in the same host country thus also indicates the plausibility of the used value.

Park and Han (2003) estimate the cost of building metros in Korea by 80-100 million USD/km (see cited in J. Pucher et.al., Public Transport Reforms in Seoul, p.56; The study for the state of construction and improvement policy of advanced transit system of Korea, 2003) (See [90]).

IEA for underground metros, Flyvberg, Seoul Metro and overall Korean metros thus all report values which are comparable to Busan. All of these data is based on independent reports and includes specifically Korean metros.

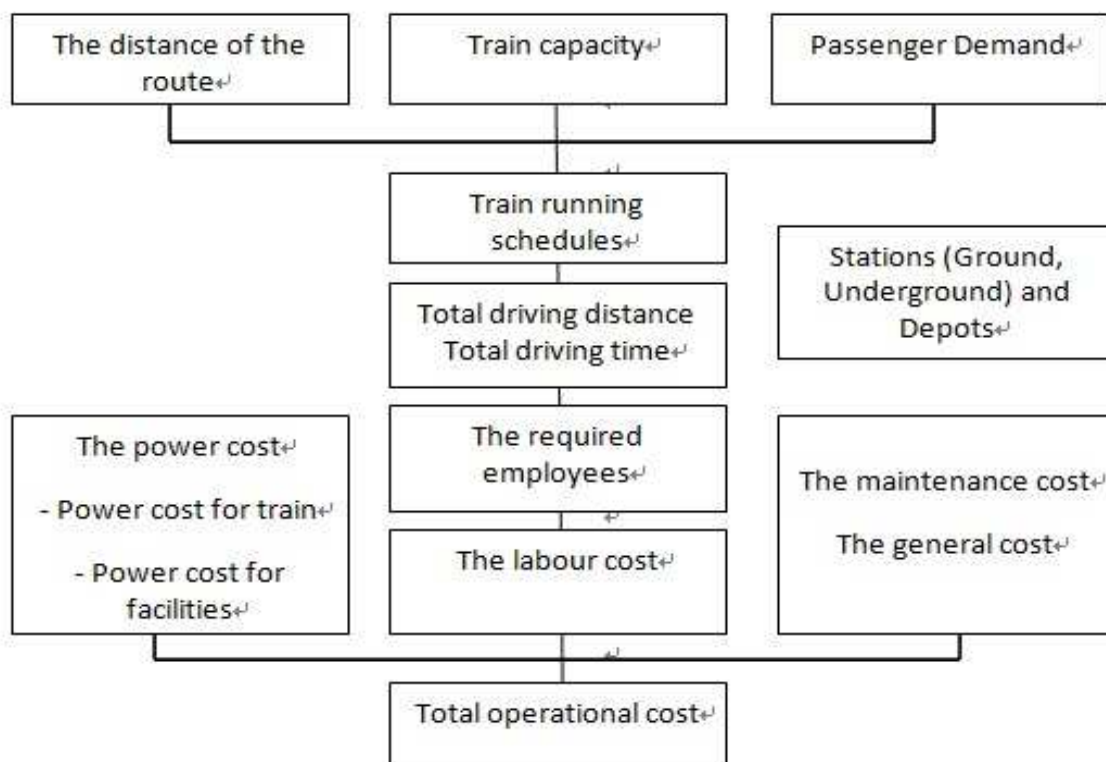
See also about the difficulty of comparing investments in metro: <http://www.railway-technical.com/finance.shtml>

The details of the **operational costs** are given in File 36b [36], [78], the labour costs are based on a yearly salary of around 50 000 US\$/person, which is more than 13% higher than in Incheon. This difference seems not to be unrealistic according to the project participant, and is based on real salaries. See answer to CL 17, which was accepted by the validation team. The operational costs per passenger compared to other cities in Korea are more than 3 times higher. An explanation was asked from the project participants (CL 17). The reasons for this difference according to the project participant: Passenger numbers for the extension are lower than for the rest of line 1 and the length of the lines in between stations are higher for the extension than for the rest (see explanation in CL 17). This seems reasonable; CL 17 could be closed.

The operational cost is based on Yusin Corporation, Chung Suk Engineering, an independent 3<sup>rd</sup> party.

Costs only include additional costs such as additional drivers or station maintenance. The projections are based on the operating lines e.g. train electricity consumption per passenger of operating lines and are therefore reliable. The level of wages in the domestic metro was considered to estimate the average wage of the officials and the estimated wage was applied to calculate the operational labour cost. Maintenance cost are based on the current maintenance costs of trains applied to the additional trains. Overhead costs (7%) are based on the current overhead costs.

The operational cost estimate follows this process:



As it is an extension of a line the operational cost per passenger are relatively high. This is logic as the end parts of lines (as is the case in extensions) have less passengers than the central parts whilst having often higher costs due to longer distance between stations and therefore over-proportional electricity usage and train cost.

The extension is 8 km with 6 stations i.e. 1.33 km on average between each station whilst the line 1 of which the project is an extension has 34 stations ([http://www.humetro.busan.kr/english/03/01\\_01.php](http://www.humetro.busan.kr/english/03/01_01.php)) with a total distance of 32.5 km i.e. an average distance between each station of 0.96k or only 72% of the extension. Electricity consumption, train staff and train maintenance is however relative to distance whilst the passenger numbers are per station.

The average daily number of passenger per station on the extension is 5,400 passengers per station (year 2014 get-on passengers both directions; see File 14 [14]) whilst the existing line had on average in the year 2009 11,400 passengers per day per station (See file Pax Lines Busan 2009, [91]) i.e. 220% more per station. Summarized for an extension as is the project the evidence above clearly shows that the additional costs are significantly higher than on the existing line whilst the number of passenger per station are significantly less thus leading to highly above proportional operational costs per passenger. To compare line extension operational costs per km with full line operational costs per km is thus not adequate.

The number of employees, their salaries, the electricity cost and the maintenance cost (divided in station-, train- and system-maintenance cost) have been taken from the study of the Yusin Corporation, Chung Suk Engineering, an independent 3<sup>rd</sup> party ([78]), which was sent to SQS in responding to CL 17. These figures were discussed in detail and crosschecked during the on-site visit by the SQS' validation team and the local expert Mr Ko (KFQ). Furthermore the performed assessment is confirmed in writing on 09/11/2012 by the Korean Foundation for Quality (KFQ), regarding the assessment on operational costs analysis for Busan Metro, in which Mr Ko confirms that the background data for operational costs for Busan Metro is duly reasonable and correct in the international context.

Considering the **revenues** and especially the ticket price (CL 19) the answer of the PP says that the 1100 Won used correspond to the full rate charged 2009, and no inflation – neither for revenues, nor for investment, nor for operation costs – is included. Since public transport ticket prices are politically determined and difficult to be risen the assumption of constant ticket prices is plausible. CL 19 could be closed.

The fare box revenue with the passenger projections are based on Yusin Corporation, Chung Suk Engineering, an independent 3<sup>rd</sup> party.

The demand estimation is based on the existing line. The project is only an extension of a metro line and thus demand estimates are based primarily on the existing line and origin-destination surveys of passengers using the metro line 1. Also results of population projection were taken into account.

The revenues from advertisement, property rental and communication line rental based on the financial year between 2004 ~ 2006 and were 15%, 13% and 14% respectively (File 37c [72]). Therefore, 14% of the 3-year average revenue has applied, which is plausible.

The **CER price** was taken from the European Energy Exchange AG [41] as an average over 12 months from May 2008 to April 2009, which again is prior to the project starting date of 04/11/2009.

The financial assessment in File 34 [34] showed expenditure for land in the years 2006-2008 already, which is before the official starting date of 11/2009. During the on-site visit however, another document dated February 2012 revealed a gap between planned and effective expenditures for the land acquisition. A CL 20 was raised asking for an explanation. The project participants gave the appropriate explanations and CL 20 could be closed.

The investment analysis is based on a FSR developed by Yusin Corporation, Chung Suk Engineering, Hangaram, published 2008, prior to taking an investment decision on the metro. Land used potentially by the

metro which was property of the Municipality was valued at the price as of 2008. Data years of the FSR do not coincide with actual investment years as there has been delay. Major investment (construction, trains) in the FSR is for 2009-2013 whilst the first construction contract was only signed 11/2009 and thus major expenses only started thereafter i.e. 2010. 2006-2008 investments (the FSR previewed construction start 2009) also sum up to 10,000 million WONS whilst basic design + actual design + research and survey measurement all sum up to 23,800 i.e. studies are more than what would be expended before. As reminder total investment cost is 720,100 million WON i.e. expenditures potentially prior are 1.3%. In accordance with EB: The "Glossary of CDM terms" defines the start date of a CDM project activity as: "the earliest date at which either the implementation or construction or real action of a project activity begins". To facilitate the clear definition of this term the Board further clarified that: "In light of the above definition, the start date shall be considered to be the date on which the project participant has committed to expenditures related to the implementation or related to the construction of the project activity. This, for example, can be the date on which contracts have been signed for equipment or construction/operation services required for the project activity. Minor pre-project expenses, e.g. the contracting of services /payment of fees for feasibility studies or preliminary surveys, should not be considered in the determination of the start date as they do not necessarily indicate the commencement of implementation of the project"

The project starting date is the signature of the first construction contract being 04/11/2009. This is in accordance with the CDM Glossary of Terms. The actual construction start is, based on the construction contract, 04/11/2009 (see File 15, sheet ID 1.1.). Completion date of construction is 08/10/2014 i.e. operational start end 2014 or early 2015 which is 1 year later than in the finance spreadsheet.

Thus, SQS concludes that the project start date has been determined correctly by the PP since the years in the FSR do not reflect the actual expenditures and the project suffered a delay i.e. construction start was around 1 year later than expected. Minor pre-project expenses as have been in fact executed in the time before the project start date do not influence that date in accordance with the "Glossary of CDM Terms".

A risk factor (actual to expected passenger numbers) was established with data from the Korean metros (see table 5 below).

The different data was checked by SQS from the mentioned sources ([37], [40]); they show that all of the three metros have much less actual passengers than expected the highest ratio being 46%. A ratio of 90% (10% less passengers) is therefore highly probable.

The database for passenger numbers for Busan metro lines 1 to 3 seems to be rather old; CL 16 was therefore raised. The answer by the project proponent stated that the critical issue is not if the year recent but that projection year and actual year are the same as made by the study. The explanation is plausible and CL 16 could be closed since the risk factor had not to be fully used for proofing negative NPV without CER revenues.

**Table 5: Relation Expected to Actual Passenger Numbers of Korean Metros (1,000 passenger/day)**

City/Line		Expected	Actual	%
Seoul	Line 5	2 410 (2001)	827 (2001)	34.3
	Line 6	1 319 (2001)	284 (2001)	21.5
	Line 7	2 363 (2001)	703 (2001)	29.8
	Line 8	557 (2001)	222 (2001)	39.9
	Total	6 649	2,036	
Busan	Line 1	1 932 (2001)	544 (2001)	28.2
	Line 2	1 782 (2006)	230 (2006)	12.9
	Line 3	276 (2006)	65 (2006)	23.6
	Total	3 990	839	
Daegu	Line 1	347 (2001)	138 (2001)	39.8
	Line 2	912 (2006)	125 (2006)	13.7
	Total	1 259	263	
Incheon		1 441 (2003)	204 (2003)	14.2
Gwangju		187 (2004)	305 (2004)	16.3

Daegjeon	91 (2006)	42 (2006)	46.2
<b>Average relation actual to projected passenger numbers</b>			<b>27 %</b>
<b>Median relation actual to projected passenger numbers</b>			<b>26 %</b>

The following parameters were used for the financial assessment and validated by SQS:

**Table 7: Major Parameters for Financial Assessment**

Parameter	Value in 100 million WON	Validation
Total investment	7 201	From "BTC Line No. 1 Extension Construction Project Feasibility Study Report" [36], construction cost, table 7-2, OK
Investment by Central Government (subsidy)	4 321	60% of total investment cost, [36] table "financial analysis", OK
Investment by Municipality	2 880	Rest of total investment = 40%, OK
Operational cost (annual average)	145	Checked with [36] and [34], CL17, details in [78], see above, labour costs seemed to be higher than in Incheon, but explanation in CL17 is satisfying, OK
Fare box revenue (annual average)	189	Checked with [72], OK
Non fare box revenue (annual average)	26	Checked with [78], an average of 14% of the operational costs was adapted, OK
Price of CERs (tsd WON per tCER)	27	Checked with [41], OK
Discount rate	0%	Conservative, OK

SQS confirms that the assumptions are therefore correct and plausible.

The NPV calculations are presented in the finance File 34 [34]. The result of the calculations is a NPV of -42 500 million WON, i.e. even without applying a risk factor for less than expected passengers the project runs a deficit. The spreadsheet File 34 [34] allows the user to change the risk factor to make his own calculations. Assumptions Box C30 (yellow marked..) indicates the level of risk factor. 0% means that the project has 0% of expected passengers and 100% that the project has 100% of projected passengers. The PP inserted 30% as indicated in table 5 and saved it in this manner for convenience.

A sensitivity analysis, which can be showed very easily in the finance File [34], where the different inputs are linked, the NPV rests negative in two cases (base case, 10% lower investment costs), whereas for two cases (10% lower operational cost, 10% higher fare box revenues) a risk factor of 10% less passengers had to be applied for a negative NPV:

**Table 8: NPV Sensitivity to Parameter Changes Excluding CER Revenues (100 million WON)**

Case	No risk factor	10% less passengers than expected
Base case	-425	-638
10% lower investment cost	-170	-383
10% lower operational cost	7	-249
10% higher fare box revenue	140	-129

This seems reasonable if one considers Table 5 above, where risk factors up to more than 70% less passengers could be expected.

SQS confirms therefore, that the assumptions and the financial calculation correspond to the guidelines and represent a conservative approach to the demonstration of additionality regarding the financial aspect.

No.:	CAR 1	Reference:	PDD Table 6
Validator request:	According to File 34 there is a salvage value of 329 x 100 million WON for land		
Project owner response:	The full value (100%) has been included as salvage value as explained in the PDD as well as the Finance file		
Validator conclusion:	Salvage value is included, OK. CAR 1 closed.	Date:	26/04/2012

No.:	CL 16	Reference:	PDD B.5 Table 5
Validator request:	The passenger numbers for Busan metro lines 1 to 3 date back to the years 2001 and 2006. Newer data are certainly available.		
Project owner response:	Table 5 compares projections with actual values of passengers for various cities and is based on a report realized by a university. The critical issue is thereby not to have the most recent data but to compare projections and actual data. Important is thus to have projection and actual data year coincide e.g. 2001 and 2006 as made by the report. Projections are often made with 5-year gaps between years and therefore not for all years also projections are available. But as mentioned the critical issue is not if the year is very recent but that projection year and actual year are the same as made by the study.		
Validator conclusion:	Explanation is accepted. OK. CL 16 closed.	Date:	26/04/2012

No.:	CL 17	Reference:	PDD B.5 Table 7 and File 34
Validator request:	There is insufficient information about the calculation of the operational costs like additional drivers, additional mechanics and maintenance costs, additional administrative costs, and others.		
Project owner response:	File 36b has added details on how these costs were estimated as well as the cost components. File 36 is the FSR used for all finance.		
Validator conclusion:	The detailed analysis raised some more questions: 1) The labour costs per person and year in Busan are around 14% higher than in Incheon. 2) The operational costs in Busan per passenger are around 0.7 US\$, compared to the other cities in Korea this up to 3.7 times more. Please explain.		
	Date: 26/04/2012		
Project owner response:	<p>1. Labour Costs for both cities are based on what is actually paid in the already existing metro in each city. A difference of 14% between cities and between different employers does not seem unrealistic especially as the data is not based on fantasy data but based on what the current salaries in the existing systems are (Incheon as well as Busan already operate a metro line). Price comparison data show e.g. that median salaries between cities fluctuate by more than 15% or e.g. show comparing Busan with Incheon that a sqm in the city centre of Busan costs nearly 14,000 USD but only USD 2,000 in Incheon (see <a href="http://www.numbeo.com/cost-of-living/country_result.jsp?country=South+Korea">http://www.numbeo.com/cost-of-living/country_result.jsp?country=South+Korea</a>). Thus summarized the difference seems in itself normal and on the other hand the data for both cities is based on actual experience.</p> <p>2. Busan is not an entire metro line but only an extension of a metro line with 6 stations and not a full metro line. The end parts of any public transit system always have fewer passengers than the central parts reflected in the relatively low passenger numbers of the CDM project. Operational costs are however the same for stations with low or with high passenger affluence as the trains run on the entire line and have to operate in a configuration and frequency in accordance with the max demand on the line. This fact can be seen if we list the Get-On plus transit passengers from station 106 (last) to 101</p>		

(first of CDM):

106: 4,645

105: 9,392

104: 11,829

103: 14,985

102: 16,991

101: 16,931

In the reverse direction exactly the same:

106: 5,094

105: 10,350

104: 12,637

103: 15,481

102: 17,156

101: 17,460

One can see that only in stations 101 and 102 the demand gets stable whilst before it is much less with the last station having 1/4 of the stable amount in 101 ff (see for data File 14)

Additionally the distance between stations tends to be higher the more the line is in the outskirts thus again increasing costs per passenger. The metro extension is 8 km with 6 stations i.e. 1.34 km on average between stations while the existing line 1 has 32.5 km with 34 stations i.e. 0.956 km between stations i.e. the extension has 40% more space between stations increasing costs.

For these two reasons it makes no sense to compare costs per passenger for line extensions against full metro systems.

No.:	CL 18	Reference:	PDD B.5 Table 7 and finance details, File 34
Validator request:	There is intransparent information about the calculation of the revenues (fare box, other income). The figures cannot be reproduced from primary data.		
Project owner response:	File 36c has added details on how fare box and non-fare-box revenue are estimated. File 36 is the FSR used for all finance.		
Validator conclusion:	File 37c (there is no file 36c) gave some more information about fare-box revenues, but probably there is a translation error in table 8-6, where it should read 100 million/year and not Million/year. OK. CL 18 closed.		
		Date:	26/04/2012

No.:	CL 19	Reference:	PDD B.5 Table 7 and finance file
Validator request:	There is insufficient information about the choice of the ticket prices. It is specifically not clear why the price should remain constant over the entire period.		
Project owner response:	The NPV is calculated based on constant WONs. Therefore inflation is not included in any revenue, investment or cost estimate. The full fare rate of 1100 Won used corresponds to the metro Busan fare for 1 Section cash as charged 2009 (since 1.2011 the full fare rate if paying by Transportation card is for 1 Section 1100). The metro extension part of the project is only 1 section. See <a href="http://english.busan.go.kr/07community/01_01.jsp?command=view&amp;page=0&amp;nowBlock=0&amp;board_code=8&amp;d_code=01_01&amp;sn=1560">http://english.busan.go.kr/07community/01_01.jsp?command=view&amp;page=0&amp;nowBlock=0&amp;board_code=8&amp;d_code=01_01&amp;sn=1560</a>		
Validator conclusion:	The ticket price was taken as 1'100 WON in all calculations; it was	Date:	26/04/2012



on:	increased the last time by 01/12/2011. OK. CL 19 closed.
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No.:	CL 20	Reference:	PDD B.5 Table 7 and especially File 34
Validator request:	File 34 shows expenditures for construction and land acquisition already in the years 2006-2008. A newer document "Construction Proceeding Status, of February 2012" shows the comparison between real and expected costs. It is not clear why this newer document was not used for the establishment of the financial analysis since otherwise it could lead to a contradiction with prior considerations of CDM revenues. At least an explanation for the planned and later realized expenditures should be given.		
Project owner response:	<p>The data is based on the FSR dated 2008 prior taking an investment decision on the metro. Land used potentially by the metro, which was property of the Municipality, was evaluated at the price as of 2008. Data years of the FSR do not coincide with actual investment years as there has been some delay. Major investment (construction, trains) in the FSR is for 2009-2013 whilst the first construction contract was only signed 11/2009 and construction and thus major expenses only started thereafter i.e. 2010.</p> <p>As of GUIDELINES ON THE ASSESSMENT OF INVESTMENT ANALYSIS EB 62 Annex 5 point 6 "Input values used in all investment analysis should be valid and applicable at the time of the investment decision taken by the project participant". This needs to be prior project starting date as defined by the EB. The date of investment decision is 09/2009. The project starting date is the signature of the first construction contract being 04/11/2009. Therefore data of 2/2012 cannot be used in the financial assessment as all data has to have been available prior 9/2009. Also 2/12 data is only on partial investment and thus a meaningful comparison of actual and expected costs cannot yet be made as the investment is fully ongoing and some parts might be more and others less advanced than projected in the original FSR per annum.</p>		
Validator conclusion:	The explanation is correct; the proof for the timely expenditures is given with the mentioned document of February 2012, which indeed cannot be used for the financial assessment. OK. CL20 closed.	Date:	26/04/2012
Validator conclusion:	The explanation is reasonable, OK. CL17 closed.	Date:	27/04/2012

#### 3.6.4 Barrier analysis

According to the methodology ACM0016 additionality must be proven by investment analysis. The participants have followed the methodology. No further barriers were identified.

#### 3.6.5 Common practice analysis

Common practice analysis is defined in ACM0016 v2.1 as follows:

*"The investment analysis shall be complemented with an analysis of the extent to which the proposed project type has already diffused in host country. This test is a credibility check to complement the investment analysis (Step 2). For the purpose of the common practice analysis, a set of cities for comparison with the city of the project activity is defined as follows:*

- If the larger urban zone (LUZ) of the city of the project activity contains more than one million inhabitants, then the set of cities for comparison includes all cities (including the city of the project activity) in the host country with a LUZ that contains more than 1 million inhabitants;*
- If the LUZ of the city of the project activity contains less than 1 million inhabitants...*



*Collect information on which cities in the considered set of cities for comparison have already implemented a MRTS. The proposed project activity is regarded as common practice if MRTS have already been implemented in 50% of the cities in the set of cities for comparison as defined above without using the CDM."*

In table 11 of the PDD [87] Metropolitan Areas in the Republic of Korea with over 1 million inhabitants are listed together with the status concerning MRTS. The table does not contain Incheon as a separate city, since it belongs to the LUZ of Seoul. However, it was not clear why Yongin and to a lesser degree Goyang are listed as separate cities since they are also part of the SNCA Seoul National Capital Area. CL18 was raised. The answer by the PP states that there is a difference between SNCA and Seoul Metropolitan Government. The answer was sent to the local expert, who agreed with the answer of the project participant.

CL23 had to be raised, because it was not clear whether some of the Metropolitan Areas having a Metro constructed them with CDM. The answer was no and the PDD was amended, CL23 could be closed.

Metropolitan Area	MRTS	Means of Validation, answer by local expert
Seoul Metropolitan City	Metro, BRT	10 464 051 (2009), OK
Busan	Metro	3 570 000 (2011), OK
Daegu	Metro	2 509 187 (2009), OK
Gwangju	Metro	1 445 828 (2009), OK
Daejeon	Metro	1 518 540 (2010), OK
Changwon	No MRTS	1 082 100 (2010), OK
Ulsan	No MRTS	1 129 827 (2009), OK
Suwon	No MRTS	1 098 000 (2010), OK
Seongnam	No MRTS	981 390 (2011), OK
Goyang	No MRTS	937 752 (2009), OK
Yongin	No MRTS	909 425, OK Yongin City constructed LRT (Light Rail Transit) about two years ago, however, LRT has not been running at all yet because of financial problem between investor and Yongin City.

Since it was still not clear how the interpretation of the LUZ was done and how it correlates for example to the definition in Eurostat, the European Union's statistical agency, where the expression "LUZ" is coming from, CL39 was raised.

The answer by the project owner was an attempt to "translate" the expression "larger urban zone LUZ" into the situation of the Republic of Korea.

The methodology states that the LUZ needs to be taken, which is often bigger than the official number of city inhabitants. (See file 62a [83]).

A. Eurostat, the European Union's statistical agency, has created the concept of Larger Urban Zone (LUZ) in an effort to harmonise definitions of urbanisation in the European Union and in countries outside the European Union. These definitions were agreed between Eurostat and the National Statistics Offices of the different countries of the European Union at the European Commission's Urban Audit of 2004. Eurostat's objective was to have an area from a significant share of the resident commute into the city, a concept known as the "functional urban region." To ensure a good data availability, Eurostat adjusts the LUZ boundaries to administrative boundaries that approximate the functional urban region.

2. The concept of LUZ needs to be transformed to the traditional concept of city inhabitants. The functional area is therefore taken for the cities for which no metropolitan area statistics are available. The result we see below.

#### **Metropolitan Population (year 2009) of Korean Cities**

Urban Area based on functional area idem to LUZ	Population in millions
SNCA	24.38
Busan Metropolitan City	3.54
Daegu Metropolitan City	2.49
Daejeon Metropolitan City	1.48
Gwangju Metropolitan City	1.43
Ulsan Metropolitan City	1.11

Changwon (only city, 2010)	1.09
Cheongju	1.15
Jeonju	1.39
Cheonan	1.25
Pohang	1.30

File 62b SQS ref. [84]

Therefore we have 11 cities with > 1 million of which 5 have a MRTS i.e. less than 50%.

In detail for the below cities which as metropolitan or functional area have > 1 million but less than 1 million when taking only the city population data which is however NOT in line with LUZ as used by the methodology:

			<b>Total population in metropolitan area</b>
Cheongju (LUZ)	Cheongju city	643,161	1,153,443
	Cheongwon	149,783	
	Boeun	34,845	
	Okcheon	54,117	
	Yeongdong	50,426	
	Jeungpyeong	33,164	
	Jincheon	61,456	
	Goesan	36,775	
	Eumseong	89,716	
Jeonju (LUZ)	Jeonju city	635,007	1,387,253
	Iksan	306,669	
	Gimje	94,770	
	Gunsan	266,922	
	Wanju	83,885	
Cheonan (LUZ)	Cheonan city	540,832	1,245,560
	Gongju	124,172	
	Boryeong	106,754	
	Nonsan	127,097	
	Gyeryong	42,760	
	Geumsan	56,220	
	Yeongi	79,482	
	Buyeo	75,564	
	Seocheon	60,066	
	Cheongyang	32,613	
Pohang (LUZ)	Pohang city	509,475	1,300,503
	Geongju	267,466	
	Youngcheon	103,115	
	Cheongsong	26,917	
	Yeongyang	18,553	
	Yeongdeok	41,710	
	Ulsan	52,529	
	Geongsan	236,459	
	Cheongdo	44,279	

C. To assess the plausibility a check was performed with the EU LUZ empirical calculations. The plausibility is done by comparing LUZ calculations done in the EU with official city population data and thereby determining an expansion factor to determine LUZ based on city inhabitant data. All cities of the Eurostat database are taken for this purpose. The figures in the Eurostat database are an attempt at a compromise between harmonised data for all of the European Union, and with availability of statistical data, making comparisons more accurate. The data used is from the 2006 Urban Audit III, which uses information collected for 2004<sup>1</sup>. The database was made for all cities with > 500,000 inhabitants for which data was available. Eurostat published thereby data for 128 cities. The population of each city is based on national statistics (city population data). The expansion factor is defined as LUZ population/city population. The average expansion factor taking the lower 95% confidence interval for the entire database was 2.1 i.e. to determine the LUZ population the city population number must be multiplied with the factor 2.1. This is based on the empirical relationship of all Eurostat cities between LUZ and city population taking the lower 95% confidence level (File 62b [84]).

D. The metropolitan data calculated in the first table is thereafter compared with the LUZ population based on the LUZ expansion factor as determined in point 3. The table below shows for the relevant cities the population data based on Metropolitan population and a calculated LUZ based on empirical EU data for cities where no metropolitan area information is directly available by the National Statistical Authority and where the core city population is less than 1 million.

#### Population (year 2009) of Korean Cities

Urban Area	Population in millions metropolitan area	Population in millions LUZ
SNCA	24.38	Not determined
Busan Metropolitan City	3.54	Not determined
Daegu Metropolitan City	2.49	Not determined
Daejeon Metropolitan City	1.48	Not determined
Gwangju Metropolitan City	1.43	Not determined
Ulsan Metropolitan City	1.11	Not determined
Changwon (only city, 2010)	1.09	Not determined
Cheongju	1.15	1.38
Jeonju	1.39	1.35
Cheonan	1.25	1.20
Pohang	1.30	1.08

File 62b [84]

As can be seen with both approaches all included urban areas have a population of > 1 million. Therefore using 2 different approaches both coincide that the cities listed in the PDD have a population of > 1million in the larger urban area. Thus 11 cities in Korea have a LUZ of > 1 million of which 5 have a MRTS i.e. less than 50% thus proving that the project is not common practice in accordance with the methodology.

SQS concludes that the given common practice analysis is correct because it is based on the population of the LUZ at the time of the investment decision.

No.:	CL 18	Reference: PDD B.5 Table 7 and finance details, file 34
Validator request:	There is intransparent information about the calculation of the revenues (fare box, other income). The figures cannot be reproduced from primary data.	
Project owner response:	File 36c has added details on how fare box and non-fare-box revenue are estimated. File 36 is the FSR used for all finance.	
Validator conclusion:	File 37c (there is no File 36c) gave some more information about fare-box revenues, but probably there is a translation error in Table 8-6, where it should read 100 million/year	

<sup>1</sup> See File 62b [84]

and not Million/year. OK. CL18 closed.

Date: 26/04/2012

No.:	CL 23	Reference:	PDD B.5 table 9
Validator request:	It is not clear whether some of the Metropolitan Areas having a Metro have constructed their Metro(s) including the CDM.		
Project owner response:	For current metros no; sentence has been added.		
Validator conclusion:	The following sentence was added below table 9 in the PDD: No city has as of GSC started a registered CDM MRTS project. Seoul metro line 9 is a registered VCS project. Daegu, Incheon as well as Busan are in the process of CDM validation for their new metro lines. OK. CL23 closed.	Date:	26/04/2012

No.:	CL 39	Reference:	PDD A 4.1.4
Validator request:	The common practice analysis is not yet clear since the expression LUZ (larger urban zone) according to the methodology exists only in Europe. It should therefore be defined or transferred to the situation in the Republic of Korea.		
Project owner response:	Common practice analysis has been made clearer by assessing relation LUZ to common city population definition based on European cities and transferring that relation to Korean cities.		
Validator conclusion:	According to the local expert, the name of Jeonbuk (name of province) should be changed in Jeonju (name of city)	Date:	20/06/2012
Project owner response:	Jeonju is been taken. The PDD has been adapted. See Files 62a and 62b for more details.		
Validator conclusion:	PDD was adapted, new files included, CL39 closed	Date:	26/06/2012

### 3.7 Monitoring plan

The monitoring plan is described in the PDD under B7. The following data and parameters will be monitored as follows:

Data / Parameter:	NCV <sub>G/D,LPG,CNG</sub>	Means of Validation
Data unit:	MJ/kg	
Description:	Net calorific value of gasoline and diesel	
Source of data to be used:	IPCC 2006, Table 1.2	According to methodology, OK
Value of data applied for the purpose of calculating expected emission reductions in Section B.5	Gasoline: 42.5 Diesel: 41.4 LPG: 44.8 CNG: 46.5	Has been checked against the official IPCC source and found correct, OK
Description of measurement methods and procedures to be applied:	Monitoring frequency: annual Any future revision of the IPCC Guidelines is taken into account.	According to Methodology, OK
QA/QC procedures to be applied:	lower 95% confidence interval	According to Methodology, OK
Any comment:		

Data / Parameter:	EF <sub>CO<sub>2</sub>,G/D/CNG/LPG</sub>	Means of Validation
Data unit:	gCO <sub>2</sub> /MJ	
Description:	CO <sub>2</sub> emission factor for gasoline, diesel, CNG and LPG	
Source of data to be used:	IPCC 2006, Table 1.4, lower 95% confidence interval	According to Methodology, OK
Value of data applied for the purpose of calculating expected emission reductions in Section B.5	Gasoline: 67.5 Diesel: 72.6 CNG: 54.3 LPG: 61.6 The bio-fuel content of 2% in diesel is taken as 0-emission for the calculation of CO <sub>2</sub> emissions.	Has been checked against the official IPCC source and found correct. OK
Description of measurement methods and procedures to be applied:	No national value; IPCC default value lower 95% confidence interval Monitoring frequency: annual Any future revision of the IPCC Guidelines is taken into account.	According to Methodology, OK
QA/QC procedures to be applied:		Bio Fuel
Any comment:	In case bio-fuel blends are used in liquid fuels the bio-fuel share of the blend is accounted for with zero emission factor. The usage of bio-fuel is monitored annually for diesel and gasoline. The EF is thereafter adjusted based on the bio-fuel contents e.g. if the bio-fuel contents is 10% then the IPCC EF is multiplied with (100%-10%) to get the EF used. The baseline emission factors must, if the bio-fuel contents changes over time were adjusted.	According to Methodology, OK

Data / Parameter:	EF <sub>KM,B,CH<sub>4</sub></sub>	Means of Validation
Data unit:	gCO <sub>2eq</sub> /km	
Description:	CH <sub>4</sub> emission factor of CNG buses per kilometre in CO <sub>2eq</sub>	
Source of data to be used:	IPCC 2006, Table 3.2.4.	According to Methodology, OK
Value of data applied for the purpose of calculating expected emission reductions in Section B.5	162.0	Has been checked against the official IPCC source and found correct. OK
Description of measurement methods and procedures to be applied:	IPCC value as no national measurements exist Monitoring frequency: annual	According to Methodology, OK
QA/QC procedures to be applied:		
Any comment:	Any future revision of the IPCC Guidelines is taken into account.	Has been checked

	The methodology requires that CH <sub>4</sub> emissions of vehicles using gaseous fuels are included. Value of 7,715 mg CH <sub>4</sub> of IPCC is multiplied with the GWP of 21 for CH <sub>4</sub> to calculate CO <sub>2eq</sub>	against the official IPCC source and found correct. OK
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Data / Parameter:	EF <sub>KM,LPG,C/T,CH4</sub>	Means of Validation
Data unit:	gCO <sub>2eq</sub> /km	
Description:	CH <sub>4</sub> emission factor of LPG cars and taxis per kilometre in CO <sub>2eq</sub>	
Source of data to be used:	IPCC 2006, Table 3.2.4.	According to Methodology, OK
Value of data applied for the purpose of calculating expected emission reductions in Section B.5	0.5	Has been checked against the official IPCC source and found correct. OK
Description of measurement methods and procedures to be applied:	IPCC value as no national measurements exist Monitoring frequency: annual	According to Methodology, OK
QA/QC procedures to be applied:		
Any comment:	Any future revision of the IPCC Guidelines is taken into account. The methodology requires that CH <sub>4</sub> emissions of vehicles using gaseous fuels are included. 24 mg CH <sub>4</sub> of IPCC is multiplied with the GWP of 21 for CH <sub>4</sub> to calculate CO <sub>2eq</sub>	Has been checked against the official IPCC source and found correct. OK

Data / Parameter:	N <sub>x,C/T</sub>	Means of Validation
Data unit:	Vehicles	
Description:	Number of passenger cars (C) and taxis (T) using fuel type x	
Source of data to be used:	Busan Council Traffic and Korea Energy Economics Institute	According to Methodology, OK
Value of data applied for the purpose of calculating expected emission reductions in Section B.5	No change projected	OK
Description of measurement methods and procedures to be applied:	Registration statistics Monitoring frequency: annual	According to Methodology, OK
QA/QC procedures to be applied:	latest available data not elder than 3 years	According to Methodology, OK
Any comment:	Required to check if passenger cars or taxis use different fuels than those used for calculating the baseline parameter.	

Data / Parameter:	P	Means of Validation														
Data unit:	Passengers															
Description:	Total passengers transported by the project															
Source of data to be used:	BTC	According to Methodology, OK														
Value of data applied for the purpose of calculating expected emission reductions in Section B.5	<div>Table 13: Million Passengers per Year</div> <table><tr><th>2014</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th></tr><tr><td>17</td><td>17</td><td>17</td><td>17</td><td>17</td><td>18</td><td>18</td></tr></table> <div>For projections based on File 14, Yusin Corporation Inc., Chungbuk Engineering, Hanganim Inc., 2008</div>	2014	2015	2016	2017	2018	2019	2020	17	17	17	17	17	18	18	Data for <i>ex-ante</i> calculation checked with [71], OK
2014	2015	2016	2017	2018	2019	2020										
17	17	17	17	17	18	18										
Description of measurement methods and procedures to be applied:	Turnpike controls at stations and electronic smart cards. Passengers are included which enter stations of the project metro (Get On) including transfer passengers. Monitoring frequency: Continuously, aggregated at least annually	According to Methodology, OK														
QA/QC procedures to be applied:	Checked with ticket sales (average fare and income from ticket).	According to Methodology, OK														
Any comment:																

Data / Parameter:	EC <sub>PJ</sub>	Means of Validation														
Data unit:	MWh															
Description:	Electricity consumed by project metro															
Source of data to be used:	BTC	According to Methodology, OK														
Value of data applied for the purpose of calculating expected emission reductions in Section B.5	<p><b>Table 14: Electricity Consumption per Year (MWh)</b></p> <table><tr><th>2014</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th></tr><tr><td>10,025</td><td>10,118</td><td>10,212</td><td>10,283</td><td>10,335</td><td>10,427</td><td>10,500</td></tr></table> <p>For projections based on operating lines train electricity consumption per passenger</p>	2014	2015	2016	2017	2018	2019	2020	10,025	10,118	10,212	10,283	10,335	10,427	10,500	CL 36, → PDD adapted. Data for <i>ex-ante</i> calculation: CL 28, checked with [11], see also above, OK
2014	2015	2016	2017	2018	2019	2020										
10,025	10,118	10,212	10,283	10,335	10,427	10,500										
Description of measurement methods and procedures to be applied:	<p>Traction energy only</p> <p>Monitoring frequency: Continuously, aggregated at least annually</p> <p>There are two substation converters for the station, which include the shops and station office electricity (AC), and traction electricity (DC). The transformer converts 22.9 kV to 1500 DC for traction energy. The measurement of DC1500V for the train is checked in the rectifier, which includes the watt-hour meter of BTC. Total electricity consumed is registered by KEPCO, which owns and calibrates the meters. Traction energy is only recorded by BTC. The DTRO equipment is not calibrated since it is attached in the rectifier (see for details Section B.7.2.)</p>	CL 36, PDD adapted OK														
QA/QC procedures to be applied:	<p>Control with electricity invoices. The electricity meters are calibrated by the local electricity board. The electricity meters are not owned or managed by Daegu Metropolitan Transit Corporation but by KEPCO. Latter is also responsible for their periodic calibration. Electricity meters are calibrated, depending on the electricity meter type, every 7 to 15 years based on regulations of the Ministry of Knowledge Economy (File 59, [60]).</p>	According to Methodology, CL 35, adapted														
Any comment:	<p>Used to calculate together with the emission factor grid the DPE as per the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”.</p>	According to Methodology, OK														

Data / Parameter:	MS <sub>i</sub>	Means of Validation
Data unit:	Percentage	
Description:	Net share of passengers using the metro which would have used baseline mode <i>i</i> (%)	
Source of data to be used:	Survey realized by external survey company	According to Methodology, OK
Value of data applied for the purpose of calculating expected emission reductions in Section B.5	<p>For projections a survey on the existing metro line 1 of Busan (survey realized 2010):</p> <p>Passenger car: 22%</p> <p>Taxi: 16%</p> <p>Motorcycle: 0%</p> <p>Bus: 61%</p> <p>NMT and induced traffic: 0%</p>	Survey 2010 [76], table BLT, OK
Description of measurement methods and procedures to be applied:	<p>Survey.</p> <p>Monitoring frequency: annual</p>	According to Methodology, OK
QA/QC procedures to be applied:	See Annex 3 for the survey design	According to Methodology, OK
Any comment:	Only used for leakage calculation of rebound effect.	According to Methodology, OK

Data / Parameter:	N <sub>B</sub>	Means of Validation
Data unit:	Buses	
Description:	Number of buses circulating in the city	

Source of data to be used:	Busan Metropolitan City Public Transportation Division, BusanTransportation corporation	Methodology asks for "Municipal transit authorities based on vehicle registration statistics from the respective city or data from vehicle control stations" OK
Value of data applied for the purpose of calculating expected emission reductions in Section B.5	2 532 None as no change in occupation rate of buses is previewed	Estimation of expected emission reduction, OK
Description of measurement methods and procedures to be applied:	Monitoring frequency: year 1, 4 and 7	According to Methodology, OK
QA/QC procedures to be applied:		
Any comment:	Monitoring is only if required i.e. if a change of occupation rate is registered	According to Methodology, OK

Data / Parameter:	OC <sub>B,T</sub>	Means of Validation
Data unit:	Passengers	
Description:	Average occupancy rate of buses and taxis	
Source of data to be used:	Survey realized by project proponent or 3 <sup>rd</sup> party	According to Methodology, OK
Value of data applied for the purpose of calculating expected emission reductions in Section B.5	No change of occupation rate previewed to baseline. Practical experience of a comparable MRTS (TransMilenio Bogota, which has a comparable outreach) has shown no negative change (reduced occupation rate) of occupation rates of baseline vehicles. See verification report TransMilenio 2009 (project 0672) (published on <a href="http://www.unfccc.int">www.unfccc.int</a> ).	Estimation of expected emission reduction. OK
Description of measurement methods and procedures to be applied:	Independent published data or in accordance with TORs of methodology Monitoring frequency: Year 1,4, and 7	According to Methodology, CL31, OK
QA/QC procedures to be applied:		
Any comment:	If available, the same sources and procedures should be used as in the baseline (bus occupation rate based on average trip distance and PKM/DD). See also TORs for such studies in case no reports are available during the monitoring period.	According to Methodology, OK

Data / Parameter:	NIZ <sub>C,T</sub>	Means of Validation
Data unit:	Vehicles	
Description:	Number of cars/taxis using affected roads	
Source of data to be used:	Survey realized by project proponent or 3 <sup>rd</sup> party	According to Methodology, OK
Value of data applied for the purpose of calculating expected emission reductions in Section B.5	No projections as no speed change is expected, thus not requiring this parameter.	Estimation of expected emission reduction. OK
Description of measurement methods and procedures to be applied:	Visual counting. Monitoring frequency: annual	According to Methodology, CL31, OK
QA/QC procedures to be applied:	Same roads, same data points, same hours and same number of days are monitored as in the baseline study (File 43).	In [43] the roads, points and days/ hours are listed, OK
Any comment:		



Data / Parameter:	TDIZ <sub>C,T</sub>	Means of Validation
Data unit:	Kilometres	
Description:	Distance driven by taxis and passenger cars on affected roads	
Source of data to be used:	Survey realized by project proponent or 3 <sup>rd</sup> party	According to methodology, survey [76] OK
Value of data applied for the purpose of calculating expected emission reductions in Section B.5	No projections as no speed change is expected, thus not requiring this parameter.	OK
Description of measurement methods and procedures to be applied:	Visual tracking of samples of vehicles entering/exiting the affected roads registering the entry and the exit point and measuring the distance by GPS or other means Monitoring frequency: annual	According to methodology, OK
QA/QC procedures to be applied:		
Any comment:		

Data / Parameter:	V <sub>P</sub>	Means of Validation
Data unit:	km/h	
Description:	Vehicle project speed on affected roads; Average moving speed is recorded.	
Source of data to be used:	Survey realized by project proponent or 3 <sup>rd</sup> party	According to methodology, survey [76] OK
Value of data applied for the purpose of calculating expected emission reductions in Section B.5	Same speed as under baseline is expected	Estimation of expected emission reduction. OK
Description of measurement methods and procedures to be applied:	On-board measurements determining the average moving speed (when circulating) on the affected road based e.g. on GPS measuring. Monitoring frequency: annual	According to methodology, CL31, OK
QA/QC procedures to be applied:	Same roads, same data points, same hours and same number of days are monitored as in the baseline study (File 43).	In [43] the roads, points and days/ hours are listed, OK
Any comment:	Only passenger cars and taxis	According to methodology, OK

Data / Parameter:	EC <sub>EL,R</sub>	Means of Validation
Data unit:	MWh	
Description:	Quantity of electricity consumed by the baseline metro line per annum	
Source of data to be used:	BTC	According to methodology, OK
Value of data applied for the purpose of calculating expected emission reductions in Section B.5	163 728 (File 11, BTC, 2011)	Checked with [11] 163 728 491 kWh for 2010, OK
Description of measurement methods and procedures to be applied:	Monitoring frequency: annual	According to methodology, OK
QA/QC procedures to be applied:		
Any comment:	Required to establish the emission factor per PKM for existing metro	According to methodology, OK

Data / Parameter:	P <sub>EL,R</sub>	
Data unit:	Passengers	

Description:	Total passengers transported by baseline metro lines per year	
Source of data to be used:	BTC	OK
Value of data applied for the purpose of calculating expected emission reductions in Section B.5	274 898 399 (File 11, BTC, 2011)	Checked with [11] for 2010, OK
Description of measurement methods and procedures to be applied:	Monitoring frequency: annual	According to methodology, OK
QA/QC procedures to be applied:		
Any comment:	Required to establish the emission factor per PKM for suburban rail	According to methodology, OK

The monitoring manual for Busan Metro Line 1 Dadae was received during the on-site visit as “CDM Monitoring Manual v1.0 03/01/2012”. The requirements of the methodology are respected. Five clarification requests had to be raised, CL 31 requires a clarification for the measurements of NIZ,  $V_P$ , OC, CL 33 asks about the responsibilities, CL 34 states that the parameter  $N_{x,CT}$  is inconsistent with the monitoring manual, which was amended in a new version of the monitoring manual (CDM MM v1.1 15/03/2012); CL 35 and CL 36 ask for a clarification regarding the calibration of the electricity meters and the exact measurement of the electricity. Three CLs were cleared by amending the PDD and supplying additional documents. The measurement of the traction energy (CL 36) for the new line 2 is described in detail in File 60; the electricity distribution, the calibration frequencies, the transmission losses, the value control, the invoice contain and the calculation of traction electricity consumption is shown in diagrams and explanations. The explanation for the measurements of NIZ,  $V_P$ , OC is satisfying, thus CL 31, CL 33, CL 34, CL 35, CL 36 could be closed.

A FAR1 was raised since the parameters  $OC_{B,T}$ ,  $NIZ_{C,T}$  and  $V_P$  have to be measured with a survey performed in accordance with the TOR before the start of the metro in order to have their reliable values for the comparison with the later surveys. The FAR was not accepted by the PP because the mentioned parameters are available prior validation and therefore listed in Chapter B.7.1 and will not be measured a second time. The explanation is correct and FAR1 was closed.

SQS states that the monitoring is feasible with the project design and that the monitoring can be implemented by the PP according to the monitoring plan.

No.:	CL 31	Reference: PDD B.7.1 page 53/54
Validator request:	It is not clear, how it will be assured that the measurements of NIZ, $V_P$ and OC will always be done in the same way. DOE did not get any TOR's.	
Project owner response:	<p><math>V_B</math> is based on moving and average speed. File 43 contains the points of measurement. Therefore the method of measuring is irrelevant. If an 3<sup>rd</sup> party source such as in the baseline continues to publish speed data latter will be used.</p> <p>OC: The methodology has in its annexes TORs. This is referenced in B.7.1. where we have <math>OC_{B,T}</math>.</p> <p>NIZ needs no TORs but requires to fix locations. This is done. The baseline study, which has now been referenced clearly in this parameter in B.7.1. has the sites and locations and times when the vehicle counting is done (File 43)</p>	
Validator conclusion:	OK, explanation is adequate. CL 31 closed.	Date: 26.04.2012

No.:	CL 33	Reference:	PDD B.7.2 Monitoring manual
Validator request:	It is not clear after the discussion during the on-site visit if Grütter Consulting AG is really responsible for the monitoring reports of the whole crediting period since they are no more project participants.		
Project owner response:	GC is NOT responsible. The PDD and the MM have been clarified.		
Validator conclusion:	New version of MM and PDD are adapted. OK. CL 33 closed.	Date:	26/04/2012

No.:	CL 34	Reference:	PDD B.7.1 page 50
Validator request:	The description of the parameter $N_{x,CT}$ is inconsistent with the monitoring manual (number of cars or % of types?).		
Project owner response:	The MM has been corrected. See version 1.1		
Validator conclusion:	Correction of MM is OK. CL 34 closed.	Date:	26/04/2012

No.:	CL 35	Reference:	PDD B.7.1 page 52
Validator request:	It is not clear whether the electricity meters will be calibrated by an officially accredited organization.		
Project owner response:	According to government regulations the electricity meters (depending on the type) are calibrated every 7-10 years. This is for total electricity consumption. The electricity meters are from KEPCO and managed by KEPCO and not the metro. Therefore the metro i.e. the PP does not calibrate the meters because it does not have the competence to do this. The PDD has been amended. See also File 59 and 60.		
Validator conclusion:	OK but see also CL 36. CL 35 closed.	Date:	26/04/2012

No.:	CL 36	Reference:	PDD B.7.1 page 52
Validator request:	It is not clear how the electricity consumed will really be measured. There are measurements at the substations (22.9 kV), which can be checked with the bills. The electricity consumption of the traction, however, is measured at 1500 V DC. In between there are other consumptions and losses.		
Project owner response:	See File 60 and changes in PDD		
Validator conclusion:	There is probably a printing error in the PDD p58 at Data/Parameter $EC_{PJ}$ , where under QA/QC the electricity meters are said not to be owned by <b>Daegu Metropolitan Transit Corporation</b> . Please correct, when necessary. Furthermore File 60 shows the monthly invoice, which is based on KEPCO's measurements at Nopo Substation at 22.9kV. The relation between the invoice and the measurement of the traction energy at 1500V is not yet clear or with other words, it is not yet clear how the losses for the transformers and rectifiers will be divided up.		
		Date:	26/04/2012
Project owner response:	PDD under B.7.1 was corrected. The control with the electricity invoice is for the total. Electricity consumption is based on the substation for traction.	Date:	05/07/2012
Validator conclusion:	Amendment and explanation OK. CL 36 closed	Date:	06/07/2012

No.:	FAR 1	Reference:	PDD B.6.2 / B.7.1 and monitoring plan
Validator request:	Before the start of the metro the parameters $OC_{B,T}$ , $NIZ_{C,T}$ and $V_P$ have to be measured with a survey performed in accordance with the TOR in order to have their reliable values for the comparison with the later surveys.		
Project owner response:	No. OC, NIZ and VB are, in accordance with the methodology, parameters available prior validation and therefore in B.6.2. They are thereafter monitored to determine leakage once the project is operational as listed in B.7.1. Baseline factors will however NOT be determined a 2 <sup>nd</sup> time prior project start.		
Validator conclusion:	The answer corresponds to the methodology and the validators. FAR 1 is closed.	Date:	28.04.2012

### 3.8 Sustainable development

The letter of approval from the host party was not available, therefore, CL 1 was raised. It was received on 18/07/2012 and confirmed that the project contributes to sustainable development in the Republic of Korea (point 3 of LoA issued).

### 3.9 Local stakeholder consultation

The local stakeholder consultation is described in Section E1 of the PDD: The project realized a stakeholder meeting at the Civic Hall in Busan on 25/01/2007 with 11 speakers and over 400 attendees.

The stakeholder meeting was public and announced through the press on 25/01/2007.

Also as part of the EIA a public hearing was made. Between 22/04/2009 and 21/05/2009 the project was publicly displayed and a public hearing session was made 30/04/2009 at Saha District Office. This session was announced in the newspaper Seoul News on 22/04/2009.

A report of the stakeholder meeting was realized and was looked at during the on-site visit. The meeting presented the project including the basic plan and routes. 59 submissions were received, 43 of which were suggestions related to route changes, 15 related to the site of stops and 1 submission was related to the transport plan during the construction period. A stakeholder also required that disturbance of residents during construction should be limited. The stakeholder report records all interventions realized as well as all comments given.

Comments raised during the stakeholder meeting were responded. Concerning route selection the core answer given was that the route selection is based on transport demand and economic efficiency as determined in the feasibility study. It was also mentioned that the subway is complemented with bus routes in areas where the demand is not sufficient to warrant a metro.

SQS states that the stakeholder consultation was done in a correct way, all the comments were answered but could not be satisfied 100% due to cost reasons.

### 3.10 Global stakeholder consultation

The PDD v1.0 of 12/11/2011 was published on 19/11/2011 for 30 days on the UNFCCC website; no comments were received.

### 3.11 Environmental impacts

BTC is ISO14 001 certified and has received all required permits for the metro project.

An EIA was made by Yooshin Engineering Corporation 07/2009.

The conclusions of the EIA are as follows: The pre-environmental impact review has been implemented in the basic planning phase to finding the routes which have the least environmental impact. Some damages in animal and plant habitats and various types of the wastes are expected from the project construction activities. In the operation period, insignificant impact to the air pollution and the generation of wastewater and waste materials by the facility users are expected. Water will be periodically sprinkled on the construction site for reduction of dirt and a soundproof wall will be placed to minimize the noise problem. Waste will be disposed in accordance with legal procedures. During the operation period, the waste impact will be minimized by working with specialized organizations.

Busan Metropolitan City notified BTC of the approval of the metro construction through the Ministry of Land, Transportation and Maritime Affairs as of 27/01/2010 in accordance with the "Metro Act" Art. 4, clause 3. The Ministry of Land, Transportation and Maritime Affairs approved the Traffic Impact Assessment for Busan Extension Metro Line 1 as of 17/12/2009. The same Ministry also confirms that the environmental impact assessment has been realized in accordance with the law of EIA Art. 19, as of 16/09/2009. See File 58 [59].

CL32 had to be raised, since it was not clear even after the on-site visit, whether the project respects all the legal requirements mentioned above. A new document was added (File 58) [59], where the mayor of Busan and the Minister of Land transportation and maritime affair require the fulfilment of all reduction measures mentioned in the EIA) and the PDD was amended accordingly. But there seems to be a printing error, since in the PDD the metro act refers to Daegu Metro line 3. CL 32 is closed.

The appropriate documents were proved by SQS and are in accordance with the declarations in the PDD. Therefore the legal compliance of the project is given.

No.:	CL 32	Reference:	PDD D2
Validator request:	It is not clear whether the project complies with all legal requirements. There is insufficient information about the requirements stated and about official approval that these requirements are met. The metro act is not mentioned.		
Project owner response:	See all approvals in File 58. The PDD has been amended in Section D2		
Validator conclusion:	There seems to be a printing error in the PDD, Section D.2, where Daegu Metro line 3 is mentioned instead of Busan Metro Line 1, Dadae. File 58 [59] states that the city of Busan and the Minister of Land transportation and maritime affair require the fulfilment of all reduction measures mentioned in the EIA. Open	Date:	29/04/2012
Project owner response:	PDD version 1.4 of 30/04/2012 corrected under D.2.,	Date:	30/04/2012
Validator conclusion:	Correction OK, CL 32 closed	Date:	20/06/2012

### 3.12 Validation protocol

In order to ensure transparency and organize the corrective or additional information and measures a validation protocol was established for the project (see Appendix F). The protocol shows in transparent manner the criteria (requirements), the means of validation and the results from validating the identified criteria including any resulting CAR, FAR and CL.

## 4 List of Interviewees and Documents Reviewed

The on-site audit and interviews were done according to the on-site visit programme (see appendix A).  
The following stakeholders were interviewed during the validation (see appendix B).  
The following documents were assessed during the validation (see appendix C).

## 5 Validation Team and Reviewer

The following matrix shows the names and roles of the members of the validation team and the technical reviewer. The reviewer is not a member of the validation team. Certificates of Competence for each validation team member and of the reviewer are included in Appendix D to this report. Local support was provided by KFAQ, Mr. Byungho KO, Republic of Korea.

Name	Role (1)	Country	Duties				
			Desk review	On-site audit	Resolution of CAR & CL	Report	Technical review
Hanspeter Graf	LA	Switzerland	X	X	X	X	
Jürg Liechti	TM	Switzerland	X	X			
Oliver Stankiewicz	TR	Switzerland					X

(1) LA = Lead auditor/assessor; TM = Team member; TE = Technical expert (if any); TR = Technical reviewer

## 6 Quality Control

Cross checks and/or other plausibility checks undertaken during validation are mentioned in the report or in the protocol. The draft validation report, including the initial validation findings, is checked by an internal reviewer (a member of the validation team) before being sent to the project participants. The final validation report undergoes a technical review before requesting registration of the project activity. The technical reviewer (not a member of the validation team) is qualified in accordance with SQS's qualification scheme for CDM validation and verification.

## 7 Appendix A: On-Site Visit Programme

February 6, 2012

From	To	Subject	Where	Who
08.30	10.30	Discussion of the project documents: <ul style="list-style-type: none"> <li>• General description</li> <li>• Planning, prior consideration</li> <li>• Baseline, project and emission reduction</li> </ul>	Office	Team members of South Pacific Inc. and Grütter Consulting
10.45	13.00	Discussion of the project documents (cont.): <ul style="list-style-type: none"> <li>• Investment analysis</li> <li>• Sensitivity</li> <li>• Common practice</li> </ul>	Office	Team members of South Pacific Inc. and Grütter Consulting Financial specialists of BTC
13.00	14.30	Lunch break	??	
14.30	16.30	Visit Metro Busan: Construction sites, survey points, affected roads, electricity monitoring, ...	On sites	Team members of South Pacific Inc. and Grütter Consulting Staff of BTC
16.30	19.00	Discussion of the project documents (cont.) <ul style="list-style-type: none"> <li>• Postponed items from morning discussion</li> </ul> Final discussion Metro Busan	Office	Team members of South Pacific Inc. and Grütter Consulting
19.30		Dinner	??	

The original programme with another final discussion on 07/02/2012 had to be adapted, since team members of Grütter Consulting had to leave early in the morning. Therefore, the final discussion for Busan was added on 06/02/2012 in the evening.



## 8 Appendix B: Interviews

Date 06/02/2012		
Name	Position	Issue
Rohini BALASUBRAMANIAN	Grütter Consulting	PDD, general questions
Jongmin LEE	South Pacific Consulting	PDD, general questions
Jongwhan LEE	South Pacific Consulting	PDD, general questions
Seungsam SEO	BTC	Project and technical questions
Sang Hag LEE	BTC	Project and technical questions
Suwhan WANG	BTC	Electricity statistics
Jinhan KIM	BTC	Passenger statistics
Guhyun LEE	Sinsung Engineering	Engineering
Dukyoul KIM	Kolon Global	Construction
Soogon KIM	Kolon Global	Construction
Byungho KO	KFQ, local expert	Specific questions

## 9 Appendix C: Documents Reviewed

### No. Title

- 1 File 1, Busan Metropolitan City, Statistics of Vehicle by Cities, 2011
- 2 File 2a/b, Ministry of Knowledge Economy, Korea Energy Management Corporation, 2008 Vehicle average fuel consumption research, 2009
- 3 File 3a/b, 2008 Vehicle average fuel consumption research, 2009 Busan Metropolitan Traffic Research, 2010
- 4 File 4a/b, Korea energy Economics Institute, 2008Energy consumption Survey Compiled by Korea Energy Economics Institute, 2009
- 5 File 5a/b, Korea Society of Transportation, 2009 Busan Metropolitan Traffic Research Passenger Number Research, 2010
- 6 File 6, IEA, Energy Statistics Manual, 2005
- 7 File 7a/b, KEPCO, Combined Margin, 2010
- 8 File 8, KEMCO, statistics of electric power in Korea, 2010
- 9 File 9, Ministry of Knowledge Economy, Korea Energy Management Corporation, 2008 Vehicle average fuel consumption research, 04/2009
- 10 File 10a/b, South Pacific Inc, motorcycle occupation rate survey, 2011
- 11 File 11, Busan Transportation Corporation, Team of Electricity Facility Kim Chaekeun, official Letter from BTC Electricity Consumption annual by lines, 2011
- 12 File 12a/b, BTC, stakeholder meeting report, 01/2007
- 13 File 13, Yooshin Engineering Corporation, EIA, 2009
- 14 File 14, Yusin Corporation inc., Chung Suk Engineering, Hangariminc. BTC Line No. 1 Extension Project Feasibility Report, 2008
- 15 File 15, BTC and bus producers, 2011
- 16 File 16, BTC, official letter, 17/09/2010
- 17 File 17, Korea Society of Transportation, 2010 Busan Metropolitan Traffic Research Passenger Number Research, 2011
- 18 File 18a/b, BTC, Business License, 2006
- 19 File 19, Busan Metropolitan city U-city information management team, data base management, 2010
- 20 File 20, Busan Metropolitan City, 2010 Busan statistical yearbook
- 21 File 21, Yushin Corporation, Cheingsuk Engineering, BTC Line No. 1 Extension Construction Project Feasibility, 2008
- 22 File 22, BTC, BTC Website: [http://www.humetro.busan.kr/english/02/02\\_02.php](http://www.humetro.busan.kr/english/02/02_02.php)
- 23 File 23, Dynamic Busan, Issue 52 3/2009
- 24 File 24, GTZ, Mass Transit Options, 2005
- 25 File 25a/b, BTC, construction contract 09000927, 14/11/2009
- 26 File 26a/b/c/d/e/f/g/h/i/j, various, city population, 2011
- 27 File 27, Ministry Official Notice No. 2010-230, 24/12/2010, and some revisions
- 28 File 28, Act on the Promotion of the Development, Use, and Diffusion of New and Renewable Energy[Enforcement Date 12. Apr, 2010] [Act No.10253, 12. Apr, 2010, Partial Amendment]
- 29 File 29, The Legislation Office, Oil and Substitute Energy for Petroleum regulation, Vehicle Management Regulation, 2011
- 30 File 30, DNP, En que inviarta el Gobierno Colombiano? 2009
- 31 File 31, BRT Guadalajara, 2010
- 32 File 32, Municipalidad de Guatemala, BRT data, 2010
- 33 File 33, UNFCCC, prior consideration form, 2010
- 34 File 34, Grütter Consulting, CDM finance file Busan extension Line1, 2011
- 35 File 35, The Minister of Land, Transportation and Maritime Affair, Regulation No.131, 2009
- 36 File 36, Yusin Corporation, Chung Suk Engineering, Hangaram, BTC Line No. 1 Extension

- Construction Project Feasibility Study Report, 2008
- 37 File 37, Inha University, A Comparison of feasibility studies, construction and operation on Infrastructure: Focused on Urban Subways, 2006
  - 38 File 38, GTZ, Training Course Mass Transit, 2004
  - 39 File 39, B Flyvbjerg, Cost Overruns and Demand Shortfalls in Urban Rail and Other Infrastructure, Transportation Planning and Technology, February 2007 Vol. 30, No. 1, pp. 9-30
  - 40 File 40, Ministry of Land, Transport and Maritime Affairs, Alteration to Master Plan of Daegu Metro 3th Urban Railroad, 2008
  - 41 File 41, EEX, CER price, 2008/2009
  - 42 File 42, Grütter Consulting, Finance File Incheon Metro, 2011
  - 43 File 43, Yusin Corporation, Chungbuk engineering, Hangarim Inc., BTC Line No. 1 Extension Project Feasibility Report, 2008 and Korea Society of Transportation, 2009 Busan Metropolitan Traffic Research Traffic Volume, 2010
  - 44 File 44a/b, Ministry of Environment, Korea Vehicle Emission Standards, 2011
  - 45 File 44b, Walsh, GlobalMotorVehicleEmissionsRegulations
  - 46 File 45, CORINAIR, Emission Inventory Guidebook, 23/08/2007
  - 47 File 46, IEA, Bus systems for the future, 2002
  - 48 File 47, B Flyvbjerg, Comparison of Capital Costs per Route-Kilometer in Urban Rail, EJTI, 8, no. 1 (2008), pp. 17-30
  - 49 File 48, Busan Metropolitan City Public Transportation Division, Busan Transportation Corporation, Bus data, 2011
  - 50 File 49, Korea Transportation Safety Authority, Research on Present Situation of Public Transportation 2010, 2011
  - 51 File 50, US-Korea FTA, vehicle engine size, 2011
  - 52 File 51, BTC, environmental permits
  - 53 File 52, BTC stakeholder meeting, 2007
  - 54 File 53, Grütter Consulting AG, MRTS data of cities worldwide, 2011
  - 55 File 54, BTC, official letter 07/11/2011
  - 56 File 55, Rites, DPR for Phase II Corridors of Delhi Metro, 2005
  - 57 File 56, Busan Transportation Corporation Regulation, 17/02/2010 (2<sup>nd</sup> revision)
  - 58 File 57, Association of Busan Bus Corporation, Letter Bio-fuel in Diesel, 28/02/2012
  - 59 File 58, Ministry of Land, Transportation and Maritime Affairs, approvals Extension Metro Line 1 Busan, 2009/2010
  - 60 File 59, The Ministry of Knowledge Economy, Enforcement Ordinance of Measurement Annex 13 - Verification expiration period of measuring equipment, 06/04/2011
  - 61 File 60a, BTC electricity diagram, 2012
  - 62 File 61, Prime Minister's Office, Confirmation of CDM Project Announcement Korea, 16/12/2009
  - 63 MM Busan Metro vs. 1.1.pdf
  - 64 Survey translation.docx
  - 65 surveys scanned.pdf
  - 66 PDD Busan 1.0.docx 17/11/2011
  - 67 PDD Busan 1.1.docx 30/03/2012
  - 68 PDD Busan 1.2.docx 25/04/2012
  - 69 PDD tables Metro Busan vs 12.3.2012.xls
  - 70 PDD tables Metro Busan.xls 17.11.2012
  - 71 File 14 pax data metro as of 1.5.2012.xlsx
  - 72 File 37c revenue details new.xlsx 07/06/2012
  - 73 File 37c revenue details.xlsx 07/06/2012
  - 74 PDD Busan 1.3.docx 26/04/2012
  - 75 PDD Busan 1.5 from 21.6.docx

- 76 PDD tables Metro Busan vs 29.4.2012.xls
- 77 Busan MoC.pdf
- 78 File 36b details operation cost.xlsx
- 79 File 60 distribution diagram\_en.pdf
- 80 MM Busan Metro vs. 1.0.docx 03/01/2012
- 81 Tool to calculate the emission factor for an electricity system, v1
- 82 LoA Republic of Korea, No. 2012-19 of 18/07/2012
- 83 File 62a City population and LUZ new.pdf
- 84 File 62b Population data korea and LUZ.xlsx
- 85 20120601\_iges\_er\_sheet\_griddef\_EN.xls
- 86 PDD Busan 1.4.docx from 30/04/2012
- 87 PDD Busan version 1.6 17/10/2012
- 88 File 63 Korea Energy Management Corporation, 2009 Vehicle average fuel consumption research. 2010
- 89 PDD tables Metro Busan vs 17.10.2012.xls
- 90 The study for the state of construction and improvement policy of advanced transit system of Korea, 2003
- 91 Busan pax per line 2009.xlsx, 2010
- 92 file Busan Operational Cost Evaluation (05.Nov.12)\_1.xls

## 10 Appendix D: Certificates of Competence

Name: Mr Hanspeter Graf

Scopes of expertise:		
1	Energy industries (renewable/non-renewable sources) TA 1.1: Thermal energy generation from fossil fuels as well as thermal energy from solar TA 1.2: Energy generation from renewable energy sources	 X X □
2	Energy distribution TA 2.1: Electricity distribution TA 2.2: Heat distribution	 □ □ □
3	Energy demand TA 3.1 Energy demand	 □ □
4	Manufacturing industries TA 4.1: Cement sector TA 4.2: Aluminium TA 4.3: Iron and steel TA 4.4: Refinery	 X □ □ X □
5	Chemical industry TA 5.1: Chemical process industries	 □ □
6	Construction TA 6.1: Construction	 □ □
7	Transport TA 7.1: Transport	 X X
8	Mining/mineral production TA 8.1: Mining and mineral processes, excluding those included in TA 8.2 below TA 8.2: Oil and gas industry, coal mine methane recovery and use	 □ □ □
9	Metal production TA 9.1: Metal production	 X X
10	Fugitive emissions from fuels TA 10.1: Mining and mineral processes, excluding those included in TA 10.2 below TA 10.2: Oil and gas industry, coal mine methane recovery and use	 □ □ □
11	Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride TA 11.1: Chemical process industries TA 11.2: GHG capture and destruction	 □ □ □
12	Solvents use TA 12.1: Chemical process industries	 □ □
13	Waste handling and disposal TA 13.1: Waste handling and disposal TA 13.2: Animal waste management	 X X □
14	Afforestation and reforestation TA 14.1: Forestry	 □ □
15	Agriculture TA 15.1: Agriculture TA 15.2: Animal waste management	 □ □ □

**Name: Mr Jürg Liechti, PhD**

**Scopes of expertise:**

1	Energy industries (renewable/non-renewable sources) TA 1.1: Thermal energy generation from fossil fuels as well as thermal energy from solar TA 1.2: Energy generation from renewable energy sources	<input checked="" type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/>
2	Energy distribution TA 2.1: Electricity distribution TA 2.2: Heat distribution	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
3	Energy demand TA 3.1 Energy demand	<input type="checkbox"/> <input type="checkbox"/>
4	Manufacturing industries TA 4.1: Cement sector TA 4.2: Aluminium TA 4.3: Iron and steel TA 4.4: Refinery	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
5	Chemical industry TA 5.1: Chemical process industries	<input type="checkbox"/> <input type="checkbox"/>
6	Construction TA 6.1: Construction	<input type="checkbox"/> <input type="checkbox"/>
7	Transport TA 7.1: Transport	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
8	Mining/mineral production TA 8.1: Mining and mineral processes, excluding those included in TA 8.2 below TA 8.2: Oil and gas industry, coal mine methane recovery and use	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
9	Metal production TA 9.1: Metal production	<input type="checkbox"/> <input type="checkbox"/>
10	Fugitive emissions from fuels TA 10.1: Mining and mineral processes, excluding those included in TA 10.2 below TA 10.2: Oil and gas industry, coal mine methane recovery and use	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
11	Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride TA 11.1: Chemical process industries TA 11.2: GHG capture and destruction	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
12	Solvents use TA 12.1: Chemical process industries	<input type="checkbox"/> <input type="checkbox"/>
13	Waste handling and disposal TA 13.1: Waste handling and disposal TA 13.2: Animal waste management	<input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>
14	Afforestation and reforestation TA 14.1: Forestry	<input type="checkbox"/> <input type="checkbox"/>
15	Agriculture TA 15.1: Agriculture TA 15.2: Animal waste management	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

**Name: Mr Oliver Stankiewicz**

**Scopes of expertise:**

1	Energy industries (renewable/non-renewable sources) TA 1.1: Thermal energy generation from fossil fuels as well as thermal energy from solar TA 1.2: Energy generation from renewable energy sources	X <input type="checkbox"/> X
2	Energy distribution TA 2.1: Electricity distribution TA 2.2: Heat distribution	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
3	Energy demand TA 3.1 Energy demand	<input type="checkbox"/> <input type="checkbox"/>
4	Manufacturing industries TA 4.1: Cement sector TA 4.2: Aluminium TA 4.3: Iron and steel TA 4.4: Refinery	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
5	Chemical industry TA 5.1: Chemical process industries	<input type="checkbox"/> <input type="checkbox"/>
6	Construction TA 6.1: Construction	X X
7	Transport TA 7.1: Transport	X X
8	Mining/mineral production TA 8.1: Mining and mineral processes, excluding those included in TA 8.2 below TA 8.2: Oil and gas industry, coal mine methane recovery and use	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
9	Metal production TA 9.1: Metal production	<input type="checkbox"/> <input type="checkbox"/>
10	Fugitive emissions from fuels TA 10.1: Mining and mineral processes, excluding those included in TA 10.2 below TA 10.2: Oil and gas industry, coal mine methane recovery and use	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
11	Fugitive emissions from production and consumption of halocarbons and sulphur hexafluoride TA 11.1: Chemical process industries TA 11.2: GHG capture and destruction	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
12	Solvents use TA 12.1: Chemical process industries	<input type="checkbox"/> <input type="checkbox"/>
13	Waste handling and disposal TA 13.1: Waste handling and disposal TA 13.2: Animal waste management	X X X
14	Afforestation and reforestation TA 14.1: Forestry	X X
15	Agriculture TA 15.1: Agriculture TA 15.2: Animal waste management	X X X

## 11 Appendix E: Abbreviations

BRT	Bus Rapid Transit
CAR	Corrective Action Request
CDM	Clean Development Mechanism
CEF	Carbon Emission Factor
CER	Certified Emission Reduction
CH <sub>4</sub>	Methane
CL	Clarification Request
CO <sub>2</sub>	Carbon dioxide
CO <sub>2</sub> e	Carbon dioxide equivalent
DNA	Designated National Authority
FAR	Forward Action Request
GHG	Greenhouse gas(es)
GWP	Global Warming Potential
IEE	Initial Environmental Examination
IPCC	Intergovernmental Panel on Climate Change
KFQ	Korean Foundation for Quality
LFG	Landfill Gas
MP	Monitoring Plan
MRTS	Mass Rapid Transit System
MSW	Municipal Solid Waste
MVP	Monitoring and Verification Plan
N <sub>2</sub> O	Nitrous oxide
NGO	Non-governmental Organization
ODA	Official Development Assistance
PDD	Project Design Document
SQS	Swiss Association for Quality and Management Systems
UNFCCC	United Nations Framework Convention on Climate Change



**Swiss Association for Quality and  
Management Systems (SQS)**

B e r n s t r a s s e 1 0 3  
P . O . B o x 6 8 6  
C H - 3 0 5 2 Z o l l i k o f e n  
T e l . + 4 1 3 1 9 1 0 3 5 3 5  
F a x . + 4 1 3 1 9 1 0 3 5 4 5  
h e a d o f f i c e @ s q s . c h  
w w w . s q s . c h

# Appendix F: CDM Validation Protocol

**Enterprise**

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**Service**

Audit/Assessment:  
Audit/Assessment beginning/end:  
Project name:  
GBZ/Report-No.:

CDM Validation  
15/11/2011 – 12/11/2012  
Busan Metro Line 1 Dadae  
324167/P32040.33

UNFCCC Scope(s)/Technical area(s):  
UNFCCC Methodology:  
UNFCCC Scale:

7 Transport  
ACM0016 v.02  
Large

Team of auditors/assessors:

Mr Hanspeter Graf  
Mr Jürg Liechti

## Contents

Contents.....	2
Introduction .....	2
Normative References/Documents .....	2
Protocol 1: General CDM Requirements .....	3
Protocol 2: Specific Validation Activities.....	16
Protocol 3: Methodological Requirements.....	18
Protocol 4: Summary of Requests.....	37

## Introduction

[VVM] 26: The purpose of validation is to ensure a thorough, independent assessment of proposed CDM project activities submitted for registration as a proposed CDM project activity against the applicable CDM requirements.

[VVM] 35: The DOE shall raise a corrective action request (CAR) if one of the following occurs:

- The project participants have made mistakes that will influence the ability of the project activity to achieve real, measurable additional emission reductions;
- The CDM requirements have not been met;
- There is a risk that emission reductions cannot be monitored or calculated.

[VVM] 36: The DOE shall raise a clarification request (CL) if information is insufficient or not clear enough to determine whether the applicable CDM requirements have been met.

[VVM] 37: The DOE shall raise a forward action request (FAR) during validation to highlight issues related to project implementation that require review during the first verification of the project activity. FARs shall not relate to the CDM requirements for registration.

## Normative References/Documents

No.	Title	Version
[1]	CLEAN DEVELOPMENT MECHANISM VALIDATION AND VERIFICATION MANUAL	01.2
[2]	GUIDANCE ON THE ASSESSMENT OF INVESTMENT ANALYSIS	05
[3]	GLOSSARY OF CDM TERMS	06
[4]	MODALITIES AND PROCEDURES FOR A CLEAN DEVELOPMENT MECHANISM	unedited
[5]	ACM0016 "Baseline Methodology for Mass Rapid Transit Projects"	2.0
[6]	Tool to calculate baseline, project and/or leakage emissions from electricity consumption	01
[7]	Tool for the demonstration and assessment of additionality	05.2.1
[8]	GUIDELINES ON THE DEMONSTRATION AND ASSESSMENT OF PRIOR CONSIDERATION OF THE CDM	04
[9]	GUIDELINES ON THE ASSESSMENT OF INVESTMENT ANALYSIS	05
[10]	GUIDELINES FOR COMPLETING THE PDD	07
[11]	TEMPLATE FOR CDM-PDD	03
[12]		

MoV = Means of Validation, DR = Document Review, I = Interview, N/A = Not Applicable

CAR = Corrective Action Request, CL = Clarification Request, FAR = Forward Action Request

## Protocol 1: General CDM Requirements

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
<b>1</b>	<b>Validation requirements based on paragraph 37 of the CDM modalities and procedures</b>				
<b>1.1</b>	<b>APPROVAL</b>				
[1] 44	All Parties involved have approved the project activity.		DR	CL1 OK	OK
	Comment: CL1: Letter of approval not yet received LoA received 18/07/2012 → CL1 closed				
1.1.1 [1] 45	The DOE shall determine whether the DNA of each Party indicated as being involved in the proposed CDM project activity in section A.3 of the PDD has provided a written letter of approval. The DOE shall determine whether each letter confirms that: (a) The Party is a Party to the Kyoto Protocol; (b) Participation is voluntary; (c) In the case of the host Party, the proposed CDM project activity contributes to the sustainable development of the country; (d) It refers to the precise proposed CDM project activity title in the PDD being submitted for registration.		DR	CL1 OK	OK
	Comment: CL1: Letter of approval not yet received LoA received 18/07/2012: a) OK, b) OK, c) OK d) refers exactly to "Busan Metro Line 1 Dadae" CL1 closed				
1.1.2 [1] 46	The DOE shall determine whether the letter(s) of approval is unconditional with respect to (a) to (d) above.		DR	CL1 OK	OK
	Comment: CL1: Letter of approval not yet received LoA is unconditional, CL1 closed				
1.1.3 [1] 47	The DOE shall confirm that the letter(s) of approval was issued by the respective Party's designated national authority (DNA) and is valid for the proposed CDM project activity under validation. A list of DNAs is available on the UNFCCC CDM website.		DR	CL1 OK	OK
	Comment: CL1: Letter of approval not yet received LoA was checked by a telephone call from the local expert to Mr. Jang, jaewoo, the secretariat of the Ministry of Land, Transport and Maritime Affairs on 20 July 2012				
1.1.4 [1] 48	If the DOE doubts the authenticity of the letter of approval, the DOE shall verify with the DNA that the letter of approval is authentic.		DR	CL1 OK	OK
	Comment: CL1: Letter of approval not yet received See above				
<b>1.2</b>	<b>PARTICIPATION</b>				
[1] 51	All project participants have been listed in a consistent manner in the project documentation. Also, their participation in the project activity was approved by a Party to the Kyoto Protocol.		DR	OK	OK
	Comment: Only two participants.				
1.2.1 [1] 52	The DOE shall confirm that the project participants are listed in tabular form in section A.3 of the PDD and that this information is consistent with the contact details provided in annex 1 of the PDD. The DOE shall determine whether the participation of each project participant has been approved by at least one Party involved, either in a letter of approval or in a separate letter specifically to		DR	CL1	OK

MoV = Means of Validation, DR = Document Review, I = Interview, N/A = Not Applicable

CAR = Corrective Action Request, CL = Clarification Request, FAR = Forward Action Request

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
	approve participation. The DOE shall confirm that no entities other than those approved as project participants are included in these sections of the PDD.				
	Comment: The two participants are listed in tabular form in the PDD. CL1: Letter of approval not yet received. LoA received No other entities are included CL4, since there is not enough information about the organization between the city and the transportation corporation. Busan Transportation Corporation was created in accordance with the "Local Public Organizations Act" with the purpose of promoting public transport facilities and the welfare of citizens of Busan. Some more has been added to the PDD. → CL4 closed				
1.2.2 [1] 53	The DOE shall ensure that the approval of participation was issued from the relevant DNA and if in doubt shall verify with the DNA that the approval of participation is valid for the proposed CDM project participant.		DR	CL1 CL2 OK	OK
	Comment: CL1: Letter of approval not yet received. See above CL2: MoC not yet received. → MoC has been submitted in Form F-CDM-MOC → CL2 closed				
<b>1.3</b>	<b>PROJECT DESIGN DOCUMENT</b>				
[1] 55	The PDD used as a basis for validation shall be prepared in accordance with the latest template and guidance from the CDM Executive Board available on the UNFCCC CDM website.		DR	OK	OK
	Comment: The latest template was used: CDM-PDDversion 03 in effect as of 28.07.2006				
1.3.1 [1] 56	The DOE shall determine whether the PDD is in accordance with the applicable CDM requirements for completing PDDs.		DR	OK	OK
	Comment: Guidelines for completing the PDD and the proposed new baseline and monitoring methodologies version 07				
<b>1.4</b>	<b>PROJECT DESCRIPTION</b>				
[1] 58	The PDD shall contain a clear description of the project activity that provides the reader with a clear understanding of the precise nature of the project activity and the technical aspects of its implementation.		DR	CL3 CL6 CL12 CL13 CL22 CL24 CL29 CL38 OK	OK
	Comment: PDD is clear and understandable. Some clarification requests had to be raised: CL3: Geographical coordinates are not written in the correct format and are not representing the headquarter of BTC. CL6: A.4.3 There are no motorized rickshaws and there are more than 2 MRTS. CL12: Map 3 is not fully understandable, some explanations are missing. CL13: The mentioned feasibility reports are not included in the PDD as a document CL22: There is an addition missing in the last sentence of p.24: "... in absence of CDM..." CL24: Printing error on p.26 of original PDD. CL29: There is no <b>table</b> with the measured circulating speed (just 1 affected road) CL38: The project titles are not throughout the documents identical. All CL's are closed.				
1.4.1 [1] 59	The DOE shall confirm that the description of the proposed CDM project activity as contained in the PDD sufficiently covers all relevant elements, is accurate and that it provides the reader with a clear understanding of the nature of the proposed CDM project activity.		DR	OK	OK
	Comment: The description of the project is accurate and gives a good picture of what will be realized. It covers all relevant elements.				

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
1.4.2 [1] 60	For proposed CDM project activities in existing facilities or utilizing existing equipments, the DOE shall conduct a physical site inspection to confirm that the description in the PDD reflects the proposed CDM project activity for the following types of CDM project activities unless other means are specified in the methodology: (a) Large scale projects;		I	OK	OK
	Comment: The site visit on 06/02/2012 at construction sites gave a good accordance with the description in the PDD.				
1.4.3 [1] 61	For other individual proposed small scale CDM project activities with emission reductions not exceeding 15,000 tonnes per year, the DOE may conduct a physical site visit as appropriate.		NA		
	Comment:				
1.4.4 [1] 62	For all other proposed CDM project activities not referred to in paragraphs 59-61, the DOE shall undertake the validation by reviewing available designs and feasibility studies and may conduct comparison analysis to equivalent projects, as appropriate. The DOE may conduct physical site visit to assess the plan. For proposed CDM project activities for which the DOE does not undertake a physical site inspection, this shall be appropriately justified.		NA		
	Comment:				
1.4.5 [1] 63	If the proposed CDM project activity involves the alteration of an existing installation or process, the DOE shall ensure that the project description clearly states the differences resulting from the project activity compared to the pre-project situation.		DR	OK	OK
	Comment: Preproject situation described in the PDD, Metro line 1 is already existing, the extension for line 1 is an installation by its own with new lines (underground) and new stations.				
<b>1.5</b>	<b>BASELINE AND MONITORING METHODOLOGY</b>				
<b>1.5.1</b>	<b>General requirement</b>				
1.5.1.1 [1] 65	The DOE shall ensure that the baseline and monitoring methodologies selected by the project participants comply with the methodologies previously approved by the CDM Executive Board.		DR	OK	OK
	Comment: ACM0016 v2 is valid until 25/07/2012				
1.5.1.2 [1] 66	To ensure that the project activity meets this general requirement, the DOE shall determine whether: (a) The selected methodology is applicable to the project activity; (b) The PP has correctly applied the selected methodology.		DR	CL11 OK	OK
	Comment: Table 2 in the PDD Some uncertainties in the bio fuel → CL11 → closed				
1.5.1.3 [1] 67	The DOE shall ensure that the selected methodology applies to the project activity and has correctly been applied with respect to the following: (a) Project boundary; (b) Baseline identification; (c) Algorithms and/or formulae used to determine emission reductions; (d) Additionality; (e) Monitoring methodology.		DR	CL11 OK	OK
	Comment: Table 2 in the PDD Some uncertainties in the bio fuel → CL11 → closed				

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
<b>1.5.2</b>	<b>Applicability of the selected methodology to the project activity</b>				
1.5.2.1 [1] 68	The DOE shall validate that the selected baseline and monitoring methodology previously approved by the CDM Executive Board is applicable to the project activity, including that the used version is valid. Comment: ACM0016 v2 is valid until 25/07/2012		DR	OK	OK
1.5.2.2 [1] 69	The DOE shall apply specific guidance provided by the CDM Executive Board in respect to any approved methodology. Comment: 2 Guidances valid: Guidance related to use of additionality tool and Guidance on IPCC default values		DR	OK	OK
1.5.2.3 [1] 70	The DOE shall determine whether the methodology is correctly quoted and applied by comparing it with the actual text of the applicable version of the methodology available on the UNFCCC CDM website. Comment: Correctly quoted		DR	OK	OK
1.5.2.4 [1] 71	A selected approved methodology applies to the project activity if the applicability conditions of the methodology are met and the project activity is not expected to result in emissions other than those allowed by the methodology. The DOE shall determine whether the choice of methodology is justified, and the project participants have shown that the project activity meets each of the applicability conditions of the approved methodology or any tool or other methodology component referred to therein. This shall be done by validating the documentation referred to in the PDD and by verifying that its content is correctly quoted and interpreted in the PDD. If the DOE, based on local and sectoral knowledge, is aware that comparable information is available from sources other than the one used in the PDD, then the DOE shall cross check the PDD against the other sources to confirm that the project activity meets the applicability conditions of the methodology. Comment: Table 2 in the PDD Some uncertainties in the bio fuel → CL11 → closed		DR	CL11 OK	OK
1.5.2.5 [1] 72	If the DOE cannot make a determination regarding the applicability of the selected methodology to the proposed CDM project activity, the DOE shall request clarification of the methodology in accordance with the guidance provided by the CDM Executive Board. Comment: No clarification needs		DR	OK	OK
1.5.2.6 [1] 73	If the DOE determines that the proposed CDM project activity does not comply with the applicability conditions of the methodology, the DOE may proceed by means of requesting revision to or deviation from the methodology in accordance with the guidance provided by the CDM Executive Board. Comment:		NA	NA	
1.5.2.7 [1] 74	If the DOE has requested clarification of revision to or deviation from a methodology, the DOE shall not submit a request for registration until the CDM Executive Board has approved the proposed deviation or revision. Comment:		NA	NA	
1.5.2.8 [1] 75	Under no circumstance shall the DOE consider the submission of a request for registration as a means of seeking clarification from the CDM Executive Board on the applicability of a methodology.		NA	NA	

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
	Comment:				
<b>1.5.3</b>	<b>Project boundary</b>				
[1] 78	The PDD shall correctly describe the project boundary, including the physical delineation of the proposed CDM project activity included within the project boundary for the purpose of calculating project and baseline emissions for the proposed CDM project activity.		DR	CL5 OK	OK
	Comment: Figure 5, p15, PDD v1 CL5 asks about the context between LUZ and the metropolitan area of Busan. PDD was amended and CL5 closed.				
1.5.3.1 [1] 79	Based on documented evidence and corroborated by a site visit where required by paragraphs 59-62 above, the DOE shall determine whether the delineation in the PDD of the project boundary is correct and meets the requirements of the selected baseline methodology. The DOE also shall confirm that all sources and GHGs required by the methodology have been included within the project boundary. If the methodology allows project participants to choose whether a source or gas is to be included within the project boundary, the DOE shall determine whether the project participants have justified that choice. The DOE shall confirm that the justification provided is reasonable, based on assessment of supporting documented evidence provided by the project participants and corroborated by observations if required.		I	OK	OK
	Comment: Site visit of 06/02/2012. For including or excluding gases the conservative way was used.				
<b>1.5.4</b>	<b>Baseline identification</b>				
[1] 81	The PDD shall identify the baseline for the proposed CDM project activity, defined as the scenario that reasonably represents the anthropogenic emissions by sources of GHGs that would occur in the absence of the proposed CDM project activity.		DR	OK	OK
	Comment: Baseline identification was done exactly according to the methodology.				
[1] 82	The DOE shall confirm that any procedure contained in the methodology to identify the most reasonable baseline scenario has correctly been applied. If the selected methodology requires use of tools (such as the "Tool for the demonstration and assessment of additionality" and the "Combined tool to identify the baseline scenario and demonstrate additionality") to establish the baseline scenario, the DOE shall consult the methodology on the application of these tools. In such cases, the guidance in the methodology shall supersede the tool. The DOE shall check each step in the procedure described in the PDD against the requirements of the methodology.		DR	OK	OK
	Comment: Baseline identification was done exactly according to the methodology.				
1.5.4.1 [1] 83	If the methodology requires several alternative scenarios to be considered in the identification of the most reasonable baseline scenario, the DOE shall, based on financial expertise and local and sectoral knowledge, determine whether all scenarios that are considered by the project participants and are supplementary to those required by the methodology, are reasonable in the context of the proposed CDM project activity and that no reasonable alternative scenario was excluded.		DR	OK	OK
	Comment: All the assumptions and data used by the project participants are listed in the PDD, including their references and sources. All documentation used is relevant for establishing the baseline scenario and correctly quoted and interpreted in the PDD.				



	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
1.5.4.2 [1] 84	The DOE shall determine whether the baseline scenario identified is reasonable by validating the assumptions, calculations and rationales used as described in the PDD. It shall ensure that documents and sources referred to in the PDD are correctly quoted and interpreted. The DOE shall cross check the information provided in the PDD with other verifiable and credible sources, such as local expert opinion, if available.		DR	OK	OK
	Comment: Assumptions and data used in the identification of the baseline scenario are justified appropriately, supported by evidence and can be deemed reasonable.				
1.5.4.3 [1] 85	The DOE shall determine whether all applicable CDM requirements have been taken into account in the identification of the baseline scenario for the proposed CDM project activity, including "relevant national and/or sectoral policies and circumstances." Drawing on its knowledge of the sector and/or advice from local experts, the DOE shall confirm that all relevant policies and circumstances have been identified and correctly considered in the PDD, in accordance with the guidance by the CDM Executive Board.		DR	OK	OK
	Comment: Relevant national and/or sectoral policies and circumstances are considered and listed in the PDD.				
1.5.4.4 [1] 86	The DOE shall determine whether the PDD provides a verifiable description of the identified baseline scenario, including a description of the technology that would be employed and/or the activities that would take place in the absence of the proposed CDM project activity.		DR	OK	OK
	Comment: The approved baseline methodology has been correctly applied to identify the most reasonable baseline scenario and the identified baseline scenario reasonably represents what would occur in the absence of the proposed CDM project activity.				
<b>1.5.5</b>	<b>Algorithms and/or formulae used to determine emission reductions (see also protocol 3)</b>				
[1] 89	The steps taken and equations applied to calculate project emissions, baseline emissions, leakage and emission reductions shall comply with the requirements of the selected baseline and monitoring methodology.		DR	OK	OK
	Comment: In accordance with the methodology				
1.5.5.1 [1] 90	The DOE shall determine whether the equations and parameters in the PDD were correctly applied by comparing them to those in the selected approved methodology. If the methodology provides for selection between different options for equations or parameters, the DOE shall confirm that adequate justification was provided (based on the choice of the baseline scenario, context of the proposed CDM project activity and other evidence provided) and that the correct equations and parameters were used, in accordance with the methodology selected.		DR	OK	OK
	Comment: All assumptions and data used by the project participants are listed in the PDD, including their references and sources. All documentation used by project participants as the basis for assumptions and source of data is correctly quoted and interpreted in the PDD.				
1.5.5.2 [1] 91	The DOE shall verify the justification given in the PDD for the choice of data and parameters used in the equations. If data and parameters will not be monitored throughout the crediting period of the proposed CDM project activity but have already been determined and will remain fixed throughout the crediting period, the DOE shall assess that all data sources and assumptions are appropriate and that calculations are correct, applicable to the proposed CDM project activity and will result in a conservative estimate of the emission reductions. If data and parameters will be monitored on implementation and hence become available only after validation of the project activity, the DOE shall confirm that the estimates provided in the PDD for these data and parameters are reasonable.		DR	CL21 OK	OK



	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
	<p>Comment: CL11: The end date of construction is thought to be in end of 2014. It is not clear why the first crediting period already starts at the beginning of 2014. → Answer by PP is satisfying, CL11 closed. All values used in the PDD are considered reasonable in the context of the proposed CDM project activity.</p> <p>The baseline methodology was applied correctly to calculate project emissions, baseline emissions, leakage and emission reductions.</p> <p>All estimates of the baseline emissions can be replicated using the data and parameter values provided in the PDD.</p>				
<b>1.6</b>	<b>ADDITIONALITY OF A PROJECT ACTIVITY</b>				
[1] 94	The PDD shall describe how a proposed CDM project activity is additional.		DR	OK	OK
	Comment: According to Tool for the demonstration and assessment of additionality				
1.6.1 [1] 95	The DOE shall assess and verify the reliability and credibility of all data, rationales, assumptions, justifications and documentation provided by project participants to support the demonstration of additionality. This requires the DOE to critically assess the presented evidence, using local knowledge and sectoral and financial expertise.		DR I	OK	OK
	Comment: See part 3 and site visit together with a local expert				
1.6.2 [1] 96	The DOE shall consider tools and documents provided by the CDM Executive Board to demonstrate the additionality of proposed CDM project activities as well as specific complementary or alternative requirements included in approved CDM methodology.		DR I	OK	OK
	Comment: See part 3 and site visit together with a local expert				
<b>1.6.1</b>	<b>Prior consideration of the clean development mechanism</b>				
[1] 98	If the project activity start date is prior to the date of publication of the PDD for stakeholder comments, it shall be demonstrated that the CDM benefits were considered necessary in the decision to undertake the project as a proposed CDM project activity.		DR	OK	OK
	Comment: The appropriate guidelines were used.				
1.6.1.1 [1] 99	The DOE shall confirm that the start date of the project activity, reported in the PDD, is in accordance with the "Glossary of CDM terms". If the reported date is not in accordance with the glossary, the DOE shall raise a CAR to ensure that the start date is correctly reported in a revised PDD. In particular, for project activities that require construction, retrofit or other modifications, the date of commissioning cannot be considered the project activity start date.		DR	CL20 OK	OK
	<p>Comment: Start date is after 02/08/2008</p> <p>CL20: File 34 shows expenditures for construction and land acquisition already in the years 2006-2008. A newer document "Construction Proceeding Status, of February 2012" shows the comparison between real and expected costs. It is not clear why this newer document was not used for the establishment of the financial analysis since otherwise it could lead to a contradiction with prior considerations of CDM revenues. At least an explanation for the planned and later realized expenditures should be given.</p> <p>The answer by the PP was satisfying → CL20 closed.</p>				
1.6.1.2 [1] 100	The DOE, in accordance with the guidance from the CDM Executive Board, shall determine whether it is a new project activity (a project activity with a start date on or after 2 August 2008) or an existing project activity (a project activity with a start date before 2 August 2008).		DR	OK	OK

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
	Comment: Starting date after 02/08/2008				
1.6.1.3 [1] 101	For a new project activity, for which the PDD has not been published for global stakeholder consultation or a new methodology proposed to the CDM Executive Board before the project activity start date, the DOE shall ensure by means of confirmation from the UNFCCC secretariat that PPs had informed the host Party DNA and the UNFCCC secretariat in writing of the commencement of the project activity and of their intention to seek CDM status. If such a notification has not been provided by the project participants within six months of the project activity start date, the DOE shall determine that the CDM was not seriously considered in the decision to implement the project activity.		DR	CL15 OK	OK
	Comment: Information letters were sent and acknowledged, CL15 closed.				
1.6.1.4 [1] 102	For an existing project activity, for which the start date is prior to the date of publication of the PDD for global stakeholder consultation, the DOE shall assess the project participant's prior consideration of the CDM through document reviews and shall satisfy following requirements: (a) Evidence which must indicate that the awareness of the CDM prior to the project activity start date, and that the benefits of the CDM, were a decisive factor in the decision to proceed with the project. Evidence to support this would include, inter alia, minutes and/or notes related to the consideration of the decision by the Board of Directors, or equivalent, of the project participant, to undertake the project as a proposed CDM project activity. (b) Reliable evidence from project participants which must indicate that continuing and real actions were taken to secure CDM status for the project in parallel with its implementation. Evidence to support this should include, inter alia, contracts with consultants for CDM/PDD/methodology services, Emission Reduction Purchase Agreements or other documentation related to the sale of the potential CERs (including correspondence with multilateral financial institutions or carbon funds), evidence of agreements or negotiations with a DOE for validation services, submission of a new methodology to the CDM Executive Board, publication in newspaper, interviews with DNA, earlier correspondence on the project with the DNA or the UNFCCC secretariat.		NA		
	Comment:				
1.6.1.5 [1] 103	If evidence to support the serious prior consideration of the CDM as indicated above is not available, the DOE shall determine that the CDM was not considered in the decision to implement the project activity.		NA		
	Comment:				
<b>1.6.2</b>	<b>Identification of alternatives</b>				
[1] 105	The PDD shall identify credible alternatives to the project activity in order to determine the most realistic baseline scenario, unless the approved methodology that is selected by the proposed CDM project activity prescribes the baseline scenario and no further analysis is required.		DR	OK	OK
	Comment: Alternatives according to the methodology				
1.6.2.1 [1] 106	The DOE shall assess the list of alternatives given in the PDD and ensure that: (a) The list of alternatives includes as one of the options that the project activity is undertaken without being registered as a proposed CDM project activity; (b) The list contains all plausible alternatives that the DOE, on the basis of its local and sectoral knowledge, considers to be viable means of supplying the outputs or services that are to be supplied by the proposed CDM project activity;		DR	OK	OK

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
	(c) The alternatives comply with all applicable and enforced legislation.				
	Comment: Together with the local expert no legal non compliance could be detected.				
<b>1.6.3</b>	<b>Investment analysis (see protocol 3)</b>				
[1] 108	If the investment analysis has been used to demonstrate the additionality of the proposed CDM project activity, the PDD shall provide evidence that the proposed CDM project activity would not be: (a) The most economically or financially attractive alternative; or (b) Economically or financially feasible, without the revenue from the sale of certified emission reductions (CERs).		DR	OK	OK
	Comment: Investment analysis → see VR 3.6.3.				
[1] 109	Project participants can show this through one of the following approaches, by demonstrating that: (a) The proposed CDM project activity would produce no financial or economic benefits other than CDM-related income. Document the costs associated with the proposed CDM project activity and the alternatives identified, and demonstrate that there is at least one alternative which is less costly than the proposed CDM project activity; (b) The proposed CDM project activity is less economically or financially attractive than at least one other credible and realistic alternative; (c) The financial returns of the proposed CDM project activity would be insufficient to justify the required investment.		DR	OK	OK
	Comment: See investment analysis VR 3.6.3.				
[1] 110	The DOE shall comply with the latest version of the "Guidance on the Assessment of Investment Analysis" as provided by the CDM Executive Board and with other relevant guidance, including the latest guidelines on plant load factors "guidelines for the reporting and validation of plant load factors".		DR	OK	OK
	Comment: Latest guidance was used				
1.6.3.1 [1] 111	To verify the accuracy of financial calculations carried out for any investment analysis, the DOE shall: (a) Conduct a thorough assessment of all parameters and assumptions used in calculating the relevant financial indicator, and determine the accuracy and suitability of these parameters using the available evidence and expertise in relevant accounting practices; (b) Cross-check the parameters against third-party or publicly available sources, such as invoices or price indices; (c) Review feasibility reports, public announcements and annual financial reports related to the proposed CDM project activity and the project participants; (d) Assess the correctness of computations carried out and documented by the project participants; (e) Assess the sensitivity analysis by the project participants to determine under what conditions variations in the result would occur and the likelihood of these conditions.		DR I	OK	OK
	Comment: Financial sheet				
1.6.3.2 [1] 112	To confirm the suitability of any benchmark applied in the investment analysis, the DOE shall: (a) Determine whether the type of benchmark applied is suitable for the type of financial indicator presented;		DR I	OK	OK

MoV = Means of Validation, DR = Document Review, I = Interview, N/A = Not Applicable

CAR = Corrective Action Request, CL = Clarification Request, FAR = Forward Action Request

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
	<p>(b) Ensure that any risk premiums applied in determining the benchmark reflect the risks associated with the project type or activity;</p> <p>(c) Determine whether it is reasonable to assume that no investment would be made at a rate of return lower than the benchmark by, for example, assessing previous investment decisions by the project participants involved, and determining whether the same benchmark has been applied or if there are verifiable circumstances that have led to a change in the benchmark.</p> <p>Comment: No benchmark, NPV analysis</p>				
1.6.3.3 [1] 113	<p>The CDM Executive Board clarified that in cases where project participants rely on values from Feasibility Study Reports (FSR) that are approved by national authorities for proposed CDM project activities, DOEs are required to ensure that:</p> <p>(a) The FSR has been the basis of the decision to proceed with the investment in the project, i.e. that the period of time between the finalization of the FSR and the investment decision is sufficiently short for the DOE to confirm that it is unlikely in the context of the underlying project activity that the input values would have materially changed;</p> <p>(b) The values used in the PDD and associated annexes are fully consistent with the FSR, and where inconsistencies occur, the DOE should validate the appropriateness of the values;</p> <p>(c) On the basis of its specific local and sectoral expertise, confirmation is provided, by cross-checking or other appropriate manner, that the input values from the FSR are valid and applicable at the time of the investment decision.</p> <p>Comment: FSR was used, site visit with local expert showed that the input values are unlikely to have materially changed, the values in the PDD are consistent with the FSR.</p>		DR I	OK	OK
1.6.4	<b>Barrier analysis (see Protocol 3)</b>				
[1] 115	<p>If barrier analysis was used to demonstrate the additionality of the proposed CDM project activity, the PDD shall demonstrate that the proposed CDM project activity faces barriers that:</p> <p>(a) Prevent the implementation of this type of proposed CDM project activity;</p> <p>(b) Do not prevent the implementation of at least one of the alternatives.</p> <p>Comment: No barrier analysis</p>		NA		
1.6.4.1 [1] 116	<p>Issues that have a clear direct impact on the financial returns of the project activity cannot be considered barriers and shall be assessed by investment analysis. This does not refer to either:</p> <p>(a) Risk related barriers, for example risk of technical failure, that could have negative effects on financial performance, or</p> <p>(b) Barriers related to the unavailability of sources of finance for the project activity.</p> <p>Comment:</p>		NA		
1.6.4.2 [1] 117	<p>The DOE shall apply a two-step process to assessing the barrier analysis performed as follows:</p> <p>(a) <i>Determine whether the barriers are real.</i> The DOE shall assess the available evidence and/or undertake interviews with relevant individuals (including members of industry associations, government officials or local experts if necessary) to determine whether the barriers listed in the PDD exist. The DOE shall ensure that existence of barriers is substantiated by independent sources of data such as relevant national legislation, surveys of local conditions and national or international statistics. If existence of a barrier is substantiated only by the opinions of the project participants, the DOE shall not consider this barrier</p>		NA		

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
	<p>to be adequately substantiated. If the DOE considers, on the basis of its sectoral or local expertise, that a barrier is not real or is not supported by sufficient evidence, it shall raise a CAR to have reference to this barrier removed from the project documentation;</p> <p>(b) <i>Determine whether the barriers prevent the implementation of the project activity but not the implementation of at least one of the possible alternatives.</i></p> <p>Since not all barriers present an insurmountable hurdle to a project activity being implemented, the DOE shall apply its local and sectoral expertise to judge whether a barrier or set of barriers would prevent the implementation of the proposed CDM project activity and would not equally prevent implementation of <i>at least one of the possible alternatives</i>, in particular the identified baseline scenario.</p> <p>Comment:</p>				
<b>1.6.5</b>	<b>Common practice analysis</b>				
[1] 119	<p>For proposed large-scale CDM project activities, unless the proposed project type is first-of-its kind, common practice analysis shall be carried out as a credibility check of the other available evidence used by the project participants to demonstrate additionality. This is a test to complement the investment analysis (Step 2 of the additionality tool) or barrier analysis (Step 3 of the additionality tool) to confirm that the project activity is not widely observed and commonly carried out in the region.</p> <p>Comment: CL39: The common practice analysis is not yet clear since the expression LUZ (larger urban zone) according to the methodology exists only in Europe. It should, therefore, be defined or transferred to the situation in the Republic of Korea. → see answer by PP → CL39 closed</p>		DR I	CL39 OK	OK
1.6.5.1 [1] 120	<p>The DOE shall use its local and sectoral expertise to:</p> <p>(a) Assess whether the geographical scope (e.g. the defined region) of the common practice analysis is appropriate for the assessment of common practice related to the project activity's technology or industry type. For certain technologies, the relevant region for assessment will be local. For others, it may be transnational/global. If a region other than the entire host country is chosen, the DOE shall assess the explanation why this region is more appropriate;</p> <p>(b) Using official sources as well as local and industry expertise, determine to what extent similar and operational projects (e.g., using similar technology or practice), other than CDM project activities, were undertaken in the defined region;</p> <p>(c) If similar and operational projects, other than CDM project activities, are already "widely observed and commonly carried out" in the defined region, assess whether there are essential distinctions between the proposed CDM project activity and the other similar activities.</p> <p>Comment: Exactly according to the methodology. CL5 asks about the context between a LUZ and the metropolitan area of Busan. The PDD was amended and CL5 could be closed. CL23 raised the question about the existing MRTS and the LUZ with more than 1 million inhabitants; the question was answered and confirmed by the local expert, a sentence has been added to the PDD → CL23 could be closed</p>		DR	CL5 CL23 OK	OK
<b>1.7</b>	<b>MONITORING PLAN (see Protocol 3)</b>				
[1] 122	<p>The PDD shall include a monitoring plan. This monitoring plan shall be based on the approved monitoring methodology applied to the proposed CDM project activity.</p> <p>Comment: Monitoring plan received MM1.1 15/03/2012</p>		DR	OK	

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
1.7.1 [1] 123	<p>The DOE shall apply a two-step process to assessing compliance with this requirement as follows:</p> <p>(a) <i>Compliance of the monitoring plan with the approved methodology.</i> The DOE shall:</p> <p>(i) By means of document review, identify the list of parameters required by the selected approved methodology;</p> <p>(ii) Confirm that the monitoring plan contains all necessary parameters, that they are clearly described and that the means of monitoring described in the plan complies with the requirements of the methodology;</p> <p>(b) <i>Implementation of the plan.</i> The DOE shall, by means of review of the documented procedures, interviews with relevant personnel, project plans and any physical inspection of the proposed CDM project activity site in accordance with paragraphs 59-62, assess whether:</p> <p>(i) The monitoring arrangements described in the monitoring plan are feasible within the project design;</p> <p>(ii) The means of implementation of the monitoring plan, including the data management and quality assurance and quality control procedures, are sufficient to ensure that the emission reductions achieved by/resulting from the proposed CDM project activity can be reported ex post and verified.</p> <p>Comment: See under 3.2.2.</p>		DR I	CL33 CL34 CL35 CL36 CL37 CL38 OK	
<b>1.8</b>	<b>SUSTAINABLE DEVELOPMENT</b>				
[1] 125	<p>CDM project activities shall assist Parties not included in Annex I to the Convention in achieving sustainable development.</p> <p>Comment: See below</p>				OK
1.8.1 [1] 126	<p>The DOE shall determine whether the letter of approval by the DNA of the host Party confirms the contribution of the proposed CDM project activity to the sustainable development of the host Party.</p> <p>Comment: The LoA is not yet available. See above, LoA received and sustainable development confirmed</p>		DR	CL1 OK	OK
<b>1.9</b>	<b>LOCAL STAKEHOLDER CONSULTATION</b>				
[1] 128	<p>Local stakeholders shall be invited by the PPs to comment on the proposed CDM project activity prior to the publication of the PDD on the UNFCCC website.</p> <p>Comment: Described completely in the PDD section E.1</p>		DR	OK	
1.9.1 [1] 129	<p>The DOE shall, by means of document review and interviews with local stakeholders as appropriate, determine whether:</p> <p>(a) Comments by local stakeholders that can reasonably be considered relevant for the proposed CDM project activity, have been invited;</p> <p>(b) The summary of the comments received as provided in the PDD is complete;</p> <p>(c) The project participants have taken due account of any comments received and have described this process in the PDD.</p> <p>Comment: Described completely in the PDD section E.1 List of all comments are summarized in file 12. The remarks in this table describe the answers by the PP.</p>		DR I	OK	
<b>1.10</b>	<b>ENVIRONMENTAL IMPACTS</b>				
[1] 131	<p>Project participants shall submit documentation to the DOE on the analysis of the environmental impacts of the project activity in accordance with paragraph 37(c) of the CDM modalities and procedures.</p>		DR	OK	

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	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
	Comment: EIA could be seen, English summary in file 13				
1.10.1 [1] 132	The DOE shall confirm, by means of a document review and/or using local official sources and expertise, whether the project participants have undertaken an analysis of environmental impacts and, if required by the host Party, an environmental impact assessment.		DR I	CL32 OK	
	Comment: CL32 had to be raised since it was not clear how all the legal requirements will be respected. The answer contained some official documents, CL32 could be closed.				



## Protocol 2: Specific validation activities

<b>2.1</b>	<b>BACKGROUND</b>			
[1] 134	Project participants may contract a DOE to undertake certain specific validation activities. For such validation activities, the DOE shall apply the general means of validation and reporting requirements described above as well as those described below.			
<b>2.2</b>	<b>PROJECT DESIGN OF SMALL-SCALE CLEAN DEVELOPMENT MECHANISM PROJECT ACTIVITIES</b>			
[1] 135	The DOE shall determine whether a proposed small-scale CDM project activity meets the requirements of the simplified modalities and procedures for small-scale CDM project activities.			NA
	Comment:			
2.2.1 [1] 136	During its validation of a small-scale project activity, the DOE shall confirm that: (a) The project activity qualifies within the thresholds of the three possible types of small-scale project activities. It may include more than one component; for example, a type III methane recovery component activity and a type I electricity component activity; (b) The project activity conforms to one of the approved small-scale categories and applies the relevant tool or methodology. The DOE shall confirm that the small-scale methodologies are applied in conjunction with the general guidelines to SSC CDM methodologies, which provides guidelines on equipment capacity, equipment performance/lifetime, baseline identification for type-II/III Greenfield project activities, sampling and other monitoring-related issues; (c) The project activity is not a debundled component of a large-scale project, in accordance with the rules defined in appendix C of the simplified modalities and procedures for small-scale CDM project activities; (d) Whether an assessment of the environmental impacts of the proposed CDM project activity is required by the host Party.			NA
	Comment: In assessing the additionality of small scale CDM project activities, the DOE shall refer to the specific requirements on demonstration of additionality for small scale project activities, together with the guidance in chapter V, section E, subsection 6 and the "Non-binding best practice examples to demonstrate additionality for SSC project activities".			
<b>2.5</b>	<b>PROGRAMME OF ACTIVITIES</b>			
[1] 165	The CDM Executive Board has provided guidance and procedures for registering a programme of activities (PoA) as a single CDM project activity. In validating a PoA and any CDM programme activities (CPAs) proposed to be included in the PoA, the DOE shall, in general, apply the means of validation and reporting requirements described in this Manual. However, there are a number of requirements unique to PoAs for which additional instructions are provided below. The precise extent of validation required in each of these areas will need to be determined by the DOE, based on the type or PoA being validated.			NA
	Comment:			
<b>2.5.1</b>	<b>Operational and management arrangements for the PoA</b>			
[1] 166	The DOE shall assess the operational and management arrangements which have been established by the coordinating/managing entity in order to determine whether these arrangements are suitable for the PoA being validated. The arrangements shall be sufficient to ensure that the coordinating/managing entity will have control of all records and information related to the implementation of individual CPAs and will be in a position to ensure that each CPA is being operated in accordance with the specific requirements of the programme. Where the DOE considers the arrangements to be unsatisfactory or insufficient, a CAR shall be raised. A request for registration shall not be submitted until the CAR			NA

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CAR = Corrective Action Request, CL = Clarification Request, FAR = Forward Action Request



	has been resolved to the satisfaction of the DOE.				
	Comment:				
<b>2.5.2</b>	<b>Eligibility criteria for CPAs</b>				
[1] 167	The DOE shall assess the specified eligibility criteria in the POA-DD in order to determine whether or not these criteria are sufficient to ensure that all CPAs would comply with the CDM requirements applicable to the PoA. These requirements will include, inter alia, the means of demonstrating the additionality of the CPA and the applicability of the applied methodology. The eligibility criteria represent an essential element of ensuring the smooth functioning or programmatic CDM. Therefore, the DOE may raise CARs which ensure the ease of application of the eligibility criteria.			NA	
	Comment:				
<b>2.5.3</b>	<b>Validation of CPAs</b>				
[1] 168	The DOE shall assess any proposed CPA, which a coordinating/managing entity wishes to include in the PoA, to determine whether or not it complies with the eligibility criteria specified in the POA-DD. The means of validation to determine compliance with this requirement will be specific to the PoA. The DOE may consider a desk review of the documentation sufficient to determine compliance in certain instances. It may also consider follow-up interviews and/or site visits necessary for other types of PoA.			NA	
	Comment:				
<b>2.6</b>	<b>RENEWAL OF CREDITING PERIOD</b>				
[1] 169	When contracted to validate a proposed CDM project activity for a second or further crediting period, the DOE shall undertake a thorough reassessment of the validity of the original baseline or any updates thereto proposed by the project participants, and the corresponding estimation of emission reductions for the applicable crediting period, based on the latest version of the procedures for renewing the crediting period, the latest applicable version of approved methodology and the means of validation described in this Manual.			NA	
	Comment:				
<b>2.7</b>	<b>CHANGES TO THE START DATE OF THE CREDITING PERIOD</b>				
[1] 170	The CDM Executive Board has revised procedures for requesting post registration changes to the start date of the crediting period. The requirement for the Host Country to re-confirm that the delay in the start date of crediting period will not affect project's contribution to sustainable development was removed, and that these revised procedures also contain provisions for project activities hosted in Least Developed Countries (LDCs). If project participants wish to delay the start date of the crediting period by more than one year but less than two years, and if project participants of projects hosted by a LDC wish to delay the start date of the crediting period by more than two year but less than four years, the DOE shall validate the baseline scenario in accordance with chapter V, section E, subsection 5(d) above.			NA	
	Comment:	The validation report shall contain a description of the progress made in project implementation. Further, the DOE shall validate that the project participants have obtained written confirmation from the host Party that the delay will not alter the project's contribution to sustainable development.			

### Protocol 3: Methodological Requirements

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
<b>3</b>	<b>Methodology ACM0016: Baseline methodology for mass rapid transit projects - Version 2.0</b>				
<b>3.1</b>	<b>APPLICATION OF METHODOLOGY</b>				
<b>3.1.1</b>	<b>Title and reference of methodology</b>				
3.1.1.1	Are reference number, version number, and title of the baseline and monitoring methodology clearly indicated?		DR	OK	OK
	Comment: ACM0016 v2 → B1				
<b>3.1.2</b>	<b>Applicability of methodology</b>				
3.1.2.1	Is the applied version the most recent one and/or is this version still applicable?		DR	OK	OK
	Comment: Valid until 25/07/2012				
3.1.2.2	Is the applied methodology considered the most appropriate one?		DR	OK	OK
	Comment: Yes Mass Rapid Transit include Metros				
3.1.2.3	Applicability Criterion 1: The project constructs a new rail-based infrastructure or segregated bus lanes. The segregated bus lanes or the rail-based MRTS replace existing bus routes (e.g. through scrapping units or through closing or re-scheduling existing bus routes) operating under mixed traffic conditions.		DR	CL10 OK	OK
	Comment: New rail infrastructure. CL10: How Bus routes will be re-structured after start of the extension of Metro Line 1(extML1) → Official Letter from Busan Transportation Corporation from 07/11/2011. Examples for lines 3 and 4 in file 54. PDD was amended. CL10 closed				
3.1.2.4	Applicability Criterion 2: The methodology is not applicable for operational improvements (e.g. new or larger buses) of an already existing and operating bus lane or rail-based MRTS.		DR	OK	OK
	Comment: New rail infrastructure for extML1 → rail based				
3.1.2.5	Applicability Criterion 3: The methodology is not applicable for bus lanes replacing an existing rail-based system i.e. the existing urban or suburban rail infrastructure must remain fully (in its full length) operational.		DR	OK	OK
	Comment: MRTS is rail based, no reduction of the existing rail infrastructure is planned				
3.1.2.6	Applicability Criterion 4: The methodology is applicable for passenger transport only.		DR I	OK	
	Comment: OK				
3.1.2.7	Applicability Criterion 5: Any fuels including (liquefied) gaseous fuels or biofuel blends, as well as electricity can be used in the baseline or project case. The following conditions apply: • In the case of gaseous fossil fuels, the methodology is applicable if equal or		DR I	CL11 OK	OK

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
	<p>more gaseous fossil fuels are used in the baseline scenario than in the project activity. The methodology is not applicable in its current form if more gaseous fossil fuel is used in the project activity compared to the baseline scenario;</p> <ul style="list-style-type: none"> <li>In the case of biofuels, project buses must use the same biofuel blend (same percentage of biofuel) as commonly used by conventional comparable urban buses in the country i.e. the methodology is not applicable if project buses use higher or lower blends of biofuels than those used by conventional buses. In addition, the project buses shall not use a significantly higher biofuel blend than cars and taxis.</li> </ul>				
	Comment: CL11: Bio fuel. CER sheet and PDD amended → CL11 closed				
3.1.2.8	<p>Applicability Criterion 6: The methodology is not applicable for the implementation of air and water-based transport systems.</p>		DR I	OK	OK
	Comment: No water or air based transport OK				
3.1.2.9	<p>Applicability Criterion 7: The project system partially replaces a traditional public transport system in a given city. The methodology cannot be used in areas where currently no public transport is available.</p>		DR I	OK	OK
	Comment: Bus system existing Metro Line 1 existing				
3.1.2.10	<p>Applicability Criterion 8: The methodology is applicable for urban or suburban trips. It is not applicable for inter-urban transport.</p>		DR I	OK	OK
	Comment: extML1 is for urban and suburban trips				
3.1.2.11	<p>Applicability Criterion 9: The methodology is only applicable if the application of the procedure to identify the baseline scenario results in that a continuation of the current public transport system is the most plausible baseline scenario.</p>		DR I	OK	OK
	Comment: OK				
<b>3.1.3</b>	<b>GHG sources, sinks and reservoirs (project boundaries)</b>				
3.1.3.1	<p>Spatial extent is the entire larger urban zone of the city (LUZ).</p>		DR	CL5 OK	OK
	Comment: CL5: The context between the LUZ and the metropolitan area of Busan is not so well defined. The PDD was amended and CL5 could be closed.				
3.1.3.2	<p>The project only includes emission reductions from the MRTS lanes as outlined in the PDD. If any MRTS lane would in a later stage be extended (prolonged) beyond the originally planned route detailed in the PDD then emission reductions can only be claimed for the original lane included in the PDD.</p>		DR	OK	OK
	Comment: The original Line 1 was not a CDM-project, the extension is, therefore, not a prolongation of an already existing project.				
3.1.3.3	<p>In case of using electricity from an interconnected grid or captive power plant for the propulsion of the transport system, the project boundary also includes the power plants connected physically to the electricity system that supply power to the project, and/or the captive power plant.</p>		DR	OK	OK
	Comment: OK Figure 5				

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.										
	Are the following (3.1.3.4. – 3.1.3.7.) GHG included or excluded from the project boundaries according to the methodology?														
3.1.3.4	Type: Baseline Emissions Source: Mobile source emissions of different modes of transport due to the trips made by the passengers using the MRTS Gas(es): CO2, CH4, N2O <table><tr><th>Boundary checklist</th><th>Yes / No</th></tr><tr><td>Source and gas(es) discussed in the PDD?</td><td>Yes table 3</td></tr><tr><td>Inclusion / exclusion justified?</td><td>Yes</td></tr><tr><td>Explanation / Justification sufficient?</td><td>Yes</td></tr><tr><td>Consistency with monitoring plan?</td><td>Yes</td></tr></table>	Boundary checklist	Yes / No	Source and gas(es) discussed in the PDD?	Yes table 3	Inclusion / exclusion justified?	Yes	Explanation / Justification sufficient?	Yes	Consistency with monitoring plan?	Yes			OK	OK
Boundary checklist	Yes / No														
Source and gas(es) discussed in the PDD?	Yes table 3														
Inclusion / exclusion justified?	Yes														
Explanation / Justification sufficient?	Yes														
Consistency with monitoring plan?	Yes														
	Comment: N2O is excluded since it contributes less than 2% to the total amount of GHG → conservative														
3.1.3.5	Type: Project Activity Emissions Source: Mobile source emissions of the project transport system (MRTS) due to the trips made by the passengers using it Gas(es): CO2, CH4, N2O <table><tr><th>Boundary checklist</th><th>Yes / No</th></tr><tr><td>Source and gas(es) discussed in the PDD?</td><td>Yes table 3</td></tr><tr><td>Inclusion / exclusion justified?</td><td>Yes</td></tr><tr><td>Explanation / Justification sufficient?</td><td>Yes</td></tr><tr><td>Consistency with monitoring plan?</td><td>Yes</td></tr></table>	Boundary checklist	Yes / No	Source and gas(es) discussed in the PDD?	Yes table 3	Inclusion / exclusion justified?	Yes	Explanation / Justification sufficient?	Yes	Consistency with monitoring plan?	Yes		DR	OK	OK
Boundary checklist	Yes / No														
Source and gas(es) discussed in the PDD?	Yes table 3														
Inclusion / exclusion justified?	Yes														
Explanation / Justification sufficient?	Yes														
Consistency with monitoring plan?	Yes														
	Comment: See above														
3.1.3.6	Type: Project Activity Emissions Source: Mobile source emissions of different modes of transport due to the trips made by the passengers using the MRTS, from their trip origin to the MRTS and from the MRTS to their trip destination Gas(es): CO2, CH4, N2O <table><tr><th>Boundary checklist</th><th>Yes / No</th></tr><tr><td>Source and gas(es) discussed in the PDD?</td><td>Yes</td></tr><tr><td>Inclusion / exclusion justified?</td><td>Yes</td></tr><tr><td>Explanation / Justification sufficient?</td><td>Yes</td></tr><tr><td>Consistency with monitoring plan?</td><td>Yes</td></tr></table>	Boundary checklist	Yes / No	Source and gas(es) discussed in the PDD?	Yes	Inclusion / exclusion justified?	Yes	Explanation / Justification sufficient?	Yes	Consistency with monitoring plan?	Yes		DR	OK	OK
Boundary checklist	Yes / No														
Source and gas(es) discussed in the PDD?	Yes														
Inclusion / exclusion justified?	Yes														
Explanation / Justification sufficient?	Yes														
Consistency with monitoring plan?	Yes														
	Comment: See above														
3.1.3.7	Type: Leakage Source: Emissions due to changes of the load factors of taxis and conventional buses; and due to congestion change (incl. change of vehicle speed and induced traffic (rebound effect)) Gas(es): CO2, CH4, N2O <table><tr><th>Boundary checklist</th><th>Yes / No</th></tr><tr><td>Source and gas(es) discussed in the PDD?</td><td>Yes</td></tr><tr><td>Inclusion / exclusion justified?</td><td>Yes</td></tr><tr><td>Explanation / Justification sufficient?</td><td>Yes</td></tr><tr><td>Consistency with monitoring plan?</td><td>CL31, Yes</td></tr></table>	Boundary checklist	Yes / No	Source and gas(es) discussed in the PDD?	Yes	Inclusion / exclusion justified?	Yes	Explanation / Justification sufficient?	Yes	Consistency with monitoring plan?	CL31, Yes		DR	OK	OK
Boundary checklist	Yes / No														
Source and gas(es) discussed in the PDD?	Yes														
Inclusion / exclusion justified?	Yes														
Explanation / Justification sufficient?	Yes														
Consistency with monitoring plan?	CL31, Yes														
	Comment: Leakage included, but not used for ex-ante calculation														

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
<b>3.1.4</b>	<b>Baseline</b>				
3.1.4.1	Is the latest approved version of the "Tool for the demonstration and assessment of additionality" used?				OK
	Comment: Yes, version 05.2.1 was used, which is the latest one.				
3.1.4.2	Are all variables with >20% analyzed for their material impact? Is it necessary to analyze a variable <20%? (→ CAR)		DR	OK	OK
	Comment: A sensitivity analysis was performed with lower investment costs, lower operational costs and higher fare box revenues. These are the main variables for NPV, it is not necessary to analyze other variables.				
3.1.4.3	Have all feasible baseline scenario alternatives to the project scenario been identified and discussed in the PDD. The following alternative scenarios should, inter alia, be considered: <ul style="list-style-type: none"> <li>The proposed project activity not being registered as a CDM project activity;</li> <li>The proposed project activity being implemented at a later date in the future, without being registered as a CDM project activity;</li> <li>The continuation of the current public and individual transport systems, including (future) investments in road based infrastructure if applicable. Transport systems which are different to the proposed project activity, e.g. if a bus lane is the project activity then alternatives might be a metro and reverse.</li> </ul>		DR	CL14 OK	OK
	Comment: 5 alternatives were discussed including the above mentioned ones. CL14: The proof for decreasing share of public transit (file 24) is rather old and were collected for Seoul. → PP changed to file 20 which is for Busan and which has data until 2009 → CL14 closed				
3.1.4.4	Are the alternatives assessed in a dynamic framework for the entire crediting period, taking into account the evolutions foreseen during this period?		DR	OK	OK
	Comment: Yes, PDD tables				
<b>3.1.5</b>	<b>Demonstration and assessment of additionality</b>				
3.1.5.1	Have applicable regulatory or legal requirements been identified? Does the project activity identify correctly and exclude those options not in line with regulatory or legal requirements?		DR	CL32 OK	OK
	Comment: No non-compliance could be detected during site-visit together with the local expert. Furthermore, BTC is ISO 14001 certified. CL32: It is not clear whether the project complies with all legal requirements. The metro act is not mentioned. → New file 58, the PDD was amended in section D2 → CL32 closed				
3.1.5.2	Is the appropriate analysis method determined in the PDD (simple cost, investment comparison or benchmark analysis)?		DR	OK	OK
	Comment: Investment Comparison Method				
3.1.5.3	Simple cost analysis: At least one alternative is less costly than the project activity?			NA	
	Comment:				
3.1.5.4	Has an investment comparison analysis using NPV, IRR, ... as indicators for all alternatives that are remaining after step 1 been conducted?		DR	OK	OK
	Comment: Investment comparison analysis with NPV				
3.1.5.5	Was the latest guideline used for the investment analysis?		DR	OK	OK

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
	Comment: Yes "GUIDANCE ON THE ASSESSMENT OF INVESTMENT ANALYSIS, v2.1" was used . [9]				
3.1.5.6	Is the investment analysis based on the parameters that are standard in the market?		DR	CL17 CL18 CL19 OK	OK
	Comment: CL17: There is not enough information about operational costs like additional drivers, details of energy, additional mechanics/maintenance and additional administrative cost, and others. → New file 36 gives enough information for the judgment of the financial analysis → CL17 closed CL18: There is intransparent information about the calculation of the revenues. → File 36c was added and CL18 closed CL19: There is insufficient information about the choice of the ticket prices. → An explanation was given by the PP and CL19 could be closed The parameters are normal to public companies and more conservative than with private parties.				
3.1.5.7	Are all relevant costs and revenues (subsidies/fiscal incentives, ODA's, etc.) included?		DR	CAR1 OK	OK
	Comment: Yes, no ODAs. CAR1: According to file 34, there is a salvage value of 329 x 100 million won for land. PP: The full value (100%) has been included as salvage value as explained in the PDD as well as the finance file. → CAR1 closed				
3.1.5.8	Is the investment analysis presented in a transparent manner? Does the PP want to black-out certain elements for the publicly available version? [8]		DR	CL17 BL18 OK	OK
	Comment: Financial file 37 had to be adapted for closing of CL18 and CL19 (see above). No secret information.				
3.1.5.9	Is the period of assessment appropriate in the context of the underlying project?		DR	OK	OK
	Comment: 30 years more than required by the guidance, which is conservative.				
3.1.5.10	How is depreciation handled?		DR	OK	OK
	Comment: The NPV is based on cash flow and does not include depreciation or other non-cash items.				
3.1.5.11	Are the input values of the investment analysis valid and applicable at the time of the investment decision?		DR	OK	OK
	Comment: Yes, investment decision was on 09/2009				
3.1.5.12	Are the listed input values consistent in all calculations?		DR	OK	OK
	Comment: Yes				
3.1.5.13	For post-tax benchmarks is the actual interest payable taken into account for income tax calculation?		NA		
	Comment: Analysis is made based on NPV as required by ACM0016				
3.1.5.14	If benchmarks are used are they applicable to the project activity and the type of IRR calculation?		NA		
	Comment: Analysis is made based on NPV as required by ACM0016				

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
3.1.5.15	If internal benchmarks are used are they compatible with the financial behaviour of at least the last 3 years?  Comment: Analysis is made based on NPV as required by ACM0016		NA		
3.1.5.16	How do the benchmarks used correspond to the default ones in Appendix A of the Guidance?  Comment: Analysis is made based on NPV as required by ACM0016		NA		
3.1.5.18	Is the sensitivity analysis correctly applied and is the interpretation of the results in line with the methodology?  Comment: Table 8 in the PDD, NPV-sensitivity without applying any risk factor and with 10% less passengers than expected: 10% lower investment cost, 10% lower operational cost, 10% higher fare box revenue		DR	OK	OK
3.1.5.19	Are all variables with >20% analysed for their material impact? Is it necessary to analyse a variable <20%?  Comment: See 3.1.4.2		DR	OK	OK
3.1.5.20	Is the range of variations reasonable in the project context?  Comment: The range for the sensitivity analysis is 10%, which seems reasonable. However, it was extended until a NPV of zero, which in fact represents an enlargement of the range by 16% for higher fare box revenue until 28% for lower investment cost.		DR	OK	OK
3.1.5.21	In case of applying step 3 (barrier analysis) of the additionality tool: Is a complete list of barriers developed that prevent the different alternatives to occur?  Comment: No barrier analysis had to be applied.		NA		
3.1.5.22	In case of applying step 3 (barrier analysis): Is transparent and documented evidence provided on the existence and significance of these barriers?  Comment: No barrier analysis had to be applied.		NA		
3.1.5.23	In case of applying step 3 (barrier analysis): Is it transparently shown that the execution of at least one of the alternatives is not prevented by the identified barriers?  Comment: No barrier analysis had to be applied.		NA		
3.1.5.24	Common practice analysis: Are all larger urban zones (LUZ) in the host country with more than 1 million inhabitants, which have already implemented a MRTS, considered for common practice analysis? (official data?)  Comment: The number of inhabitants for Seongnam, Goyang and Yongin as cities lie a little below 1 million inhabitants. If one looks at the "larger urban zone" as stated by the methodology, then there are above 1 million as was acknowledged by the local expert. CL5: Context between LUZ and metropolitan area of Busan (see above). CL23: LUZ with MRTS with or without CDM (see above)		DR	CL5 CL23 OK	OK
3.1.5.25	Common practice analysis: Are at least 3 cities with inhabitants between 0.5 and 1 million people considered for the common practice analysis?  Comment: The LUZ of the city of the project has more than 1 million inhabitants.		NA		
3.1.5.26	Common practice analysis: Are in less than 50% of the considered cities MRTS implemented without CDM?		DR I	CL23 OK	OK



	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
	Comment: CL23: It is not clear whether some of the LUZ having a Metro have constructed it including CDM. PP answer = no, confirmation by local expert, PDD was amended, → CL23 closed				
3.2	DESCRIPTION OF ALL DATA AND PARAMETERS AVAILABLE AT VALIDATION, MONITORING PLAN				
3.2.1	Data available at validation				
3.2.1.1	SFC <sub>C,G/D/LPG</sub> Specific fuel consumption for passenger cars using G,D,LPG		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Correct value provided?	Yes			
	Has this value been verified?	Yes			
	Choice of data or measurement methods correctly justified?	Yes			
	Comment: See Table A1 Baseline Parameters				
3.2.1.2	SFC <sub>T,LPG</sub> Specific fuel consumption for taxis using LPG		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Correct value provided?	Yes			
	Has this value been verified?	Yes			
	Choice of data or measurement methods correctly justified?	Yes			
	Comment: See Table A1 Baseline Parameters				
3.2.1.3	SFC <sub>M,G</sub> Specific fuel consumption for motor cycles using gasoline		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Correct value provided?	Yes			
	Has this value been verified?	Yes			
	Choice of data or measurement methods correctly justified?	Yes			
	Comment: See Table A1 Baseline Parameters				
3.2.1.4	SFC <sub>D,CNG</sub> Specific consumption of buses using diesel or CNG		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Correct value provided?	Yes			
	Has this value been verified?	Yes			
	Choice of data or measurement methods correctly justified?	Yes			



	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
	Comment: See Table A1 Baseline Parameters				
3.2.1.5	<i>N<sub>I,x</sub> Numbers of vehicles per category I using fuel type x</i>		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Correct value provided?	Diff. values yes			
	Has this value been verified?	Yes			
	Choice of data or measurement methods correctly justified?	Yes			
Comment:					
3.2.1.6	<i>OC<sub>C</sub> Average occupation rate for passenger cars</i>		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Correct value provided?	Yes			
	Has this value been verified?	Yes			
	Choice of data or measurement methods correctly justified?	Yes			
Comment: See Table A1 Baseline Parameters					
3.2.1.7	<i>OC<sub>T</sub> Average occupation rate for taxis</i>		DR I	CL26 OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	CL26			
	Source clearly referenced?	Yes			
	Correct value provided?	Yes			
	Has this value been verified?	Yes			
	Choice of data or measurement methods correctly justified?	Yes			
Comment: CL26: There seem to be two kinds of taxis in Incheon, the private and the general ones, for which consumption rates and occupation rates are different. There is insufficient information about the actual situation and the used values. The PDD was amended in section B.6.1., CL26 could be closed.					
3.2.1.8	<i>OC<sub>M</sub> Average occupation rate for motor cycles</i>		DR I	CL6 OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	CL6			
	Appropriate description of parameter?	CL6			
	Source clearly referenced?	CL6			
	Correct value provided?	CL6			
	Has this value been verified?	CL6			
	Choice of data or measurement methods correctly justified?	CL6			

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
	CL6: There are no motorized rickshaws and there are more than 2 MRTS. Comment: Answer by PP: No motorized rickshaws. This has been corrected. MRTS lines has been corrected. → CL6 could be closed				
3.2.1.9	<i>OC<sub>B</sub> Average occupation rate for buses</i>		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Correct value provided?	Yes			
	Has this value been verified?	Yes			
	Choice of data or measurement methods correctly justified?	Yes			
	Comment: OK				
3.2.1.10	<i>PBL<sub>B</sub> Passengers transported by baseline buses per annum</i>		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Correct value provided?	Yes			
	Has this value been verified?	Yes			
	Choice of data or measurement methods correctly justified?	Yes			
	Comment: See Table A1 Baseline Parameters				
3.2.1.11	<i>TDBL<sub>P,B</sub> Average trip distance of passengers using buses</i>		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Correct value provided?	Yes			
	Has this value been verified?	Yes			
	Choice of data or measurement methods correctly justified?	Yes			
	Comment: OK				
3.2.1.12	<i>DD<sub>B</sub> Total distance driven by baseline buses per annum</i>		DR I	CL25 OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	CL25			
	Correct value provided?	Yes			
	Has this value been verified?	Yes			
	Choice of data or measurement methods correctly justified?	Yes			
	Comment: See Table A1 Baseline Parameters				

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
3.2.1.13	<i>AD<sub>B</sub> Average annual distance driven by buses</i>		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Correct value provided?	Yes			
	Has this value been verified?	Yes			
	Choice of data or measurement methods correctly justified?	Yes			
	Comment: See VR, 3.5.5.				
3.2.1.14	<i>AD<sub>T</sub> Average annual distance driven by taxis</i>		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Correct value provided?	Yes			
	Has this value been verified?	Yes			
	Choice of data or measurement methods correctly justified?	Yes			
	Comment: See VR				
3.2.1.15	<i>NIZ<sub>C,T,BL</sub> Number of cars, taxis on affected roads per annum in the baseline</i>		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Correct value provided?	Yes			
	Has this value been verified?	Yes			
	Choice of data or measurement methods correctly justified?	Yes			
	Comment: See VR				
3.2.1.16	<i>V<sub>B</sub> Vehicle baseline speed on affected roads</i>		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Correct value provided?	Yes			
	Has this value been verified?	Yes			
	Choice of data or measurement methods correctly justified?	Yes			
	Comment: See VR				
3.2.1.17	Is the data set complete or are there data missing?		DR	OK	OK
	Comment: Complete according to ACM0016				

MoV = Means of Validation, DR = Document Review, I = Interview, N/A = Not Applicable

CAR = Corrective Action Request, CL = Clarification Request, FAR = Forward Action Request

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
3.2.2	Data and parameters monitored				
3.2.2.1	1.1.1 $P_{EL,R}$ Total passengers transported by metro per year		DR I	CL8 OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	CL8			
	Source clearly referenced?	Yes			
	Description of measurement methods and procedures?	Yes			
	Frequency of monitoring/recording	Yes			
	Is value applied verified and correct?	Yes			
	Is monitoring equipment calibrated?				
	Are QA/QC procedures defined and applied?				
	Comment: CL8: It is not clear in which dimension the modal split rates are measured. Answer by PP: Passenger rides as is usual; has been corrected. CL8 closed				
3.2.2.2	$EC_{EL,R}$ Quantity of electricity consumed by the baseline metro per year		DR I	CL28 CL36 OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Description of measurement methods and procedures?	CL36			
	Frequency of monitoring/recording	Yes			
	Is value applied verified and correct?	CL28			
	Is monitoring equipment calibrated?				
	Are QA/QC procedures defined and applied?				
	Comment: CL28: It is not clear how the electricity consumption ex-ante of the project was estimated. PP answer: The projections have been based on the operating lines train electricity consumption per passenger as explained in B.6.2. → CL28 closed CL36: It is not clear how the electricity consumed will really be measured. There are measurements at the substations (22.9 kV) which can be checked with the bills. The electricity consumption of the traction, however, is measured at 1500 V DC. In between there are other consumptions and losses. New file 60 and changes in the PDD → CL36 closed				
3.2.2.3	$NCV_{G/D/CNG/LPG}$ Net calorific value of gasoline, diesel, CNG and LPG		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Description of measurement methods and procedures?	Yes			
	Frequency of monitoring/recording	Yes			
	Is value applied verified and correct?	Yes			
	Is monitoring equipment calibrated?				
	Are QA/QC procedures defined and applied?				
	Comment: See VR 3.7.				
3.2.2.4	$EF_{CO2,G/D/CNG/LPG}$ CO <sub>2</sub> -emission factor for gasoline, diesel, CNG and LPG		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.																				
	<table><tr><td>Data unit correctly expressed?</td><td>Yes</td></tr><tr><td>Appropriate description of parameter?</td><td>Yes</td></tr><tr><td>Source clearly referenced?</td><td>Yes</td></tr><tr><td>Description of measurement methods and procedures?</td><td>Yes</td></tr><tr><td>Frequency of monitoring/recording</td><td>Yes</td></tr><tr><td>Is value applied verified and correct?</td><td>Yes</td></tr><tr><td>Is monitoring equipment calibrated?</td><td></td></tr><tr><td>Are QA/QC procedures defined and applied?</td><td></td></tr></table>	Data unit correctly expressed?	Yes	Appropriate description of parameter?	Yes	Source clearly referenced?	Yes	Description of measurement methods and procedures?	Yes	Frequency of monitoring/recording	Yes	Is value applied verified and correct?	Yes	Is monitoring equipment calibrated?		Are QA/QC procedures defined and applied?									
Data unit correctly expressed?	Yes																								
Appropriate description of parameter?	Yes																								
Source clearly referenced?	Yes																								
Description of measurement methods and procedures?	Yes																								
Frequency of monitoring/recording	Yes																								
Is value applied verified and correct?	Yes																								
Is monitoring equipment calibrated?																									
Are QA/QC procedures defined and applied?																									
	Comment: See VR 3.7 and 3.5.5.																								
3.2.2.5	<i>EF<sub>KM,B,CH4</sub> CH<sub>4</sub>-emission factor of CNG buses in CO<sub>2eq</sub></i> <table><tr><td>Data Checklist</td><td>Yes/No/NA</td></tr><tr><td>Title in line with methodology?</td><td>Yes</td></tr><tr><td>Data unit correctly expressed?</td><td>Yes</td></tr><tr><td>Appropriate description of parameter?</td><td>Yes</td></tr><tr><td>Source clearly referenced?</td><td>Yes</td></tr><tr><td>Description of measurement methods and procedures?</td><td>Yes</td></tr><tr><td>Frequency of monitoring/recording</td><td>Yes</td></tr><tr><td>Is value applied verified and correct?</td><td>Yes</td></tr><tr><td>Is monitoring equipment calibrated?</td><td></td></tr><tr><td>Are QA/QC procedures defined and applied?</td><td></td></tr></table>	Data Checklist	Yes/No/NA	Title in line with methodology?	Yes	Data unit correctly expressed?	Yes	Appropriate description of parameter?	Yes	Source clearly referenced?	Yes	Description of measurement methods and procedures?	Yes	Frequency of monitoring/recording	Yes	Is value applied verified and correct?	Yes	Is monitoring equipment calibrated?		Are QA/QC procedures defined and applied?			DR I	OK	OK
Data Checklist	Yes/No/NA																								
Title in line with methodology?	Yes																								
Data unit correctly expressed?	Yes																								
Appropriate description of parameter?	Yes																								
Source clearly referenced?	Yes																								
Description of measurement methods and procedures?	Yes																								
Frequency of monitoring/recording	Yes																								
Is value applied verified and correct?	Yes																								
Is monitoring equipment calibrated?																									
Are QA/QC procedures defined and applied?																									
	Comment:																								
3.2.2.6	<i>EF<sub>KM,LPG,C/T,LPG</sub> CH<sub>4</sub>-emission factor of LPG cars and taxis in CO<sub>2eq</sub></i> <table><tr><td>Data Checklist</td><td>Yes/No/NA</td></tr><tr><td>Title in line with methodology?</td><td>Yes</td></tr><tr><td>Data unit correctly expressed?</td><td>Yes</td></tr><tr><td>Appropriate description of parameter?</td><td>Yes</td></tr><tr><td>Source clearly referenced?</td><td>Yes</td></tr><tr><td>Description of measurement methods and procedures?</td><td>Yes</td></tr><tr><td>Frequency of monitoring/recording</td><td>Yes</td></tr><tr><td>Is value applied verified and correct?</td><td>Yes</td></tr><tr><td>Is monitoring equipment calibrated?</td><td></td></tr><tr><td>Are QA/QC procedures defined and applied?</td><td></td></tr></table>	Data Checklist	Yes/No/NA	Title in line with methodology?	Yes	Data unit correctly expressed?	Yes	Appropriate description of parameter?	Yes	Source clearly referenced?	Yes	Description of measurement methods and procedures?	Yes	Frequency of monitoring/recording	Yes	Is value applied verified and correct?	Yes	Is monitoring equipment calibrated?		Are QA/QC procedures defined and applied?			DR I	OK	OK
Data Checklist	Yes/No/NA																								
Title in line with methodology?	Yes																								
Data unit correctly expressed?	Yes																								
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Is monitoring equipment calibrated?																									
Are QA/QC procedures defined and applied?																									
	Comment: See VR																								
3.2.2.7	<i>N<sub>x,CT</sub> Number of passenger cars and taxis using fuel type x</i> <table><tr><td>Data Checklist</td><td>Yes/No/NA</td></tr><tr><td>Title in line with methodology?</td><td>Yes</td></tr><tr><td>Data unit correctly expressed?</td><td>Yes</td></tr><tr><td>Appropriate description of parameter?</td><td>Yes</td></tr><tr><td>Source clearly referenced?</td><td>Yes</td></tr><tr><td>Description of measurement methods and procedures?</td><td>CL33</td></tr><tr><td>Frequency of monitoring/recording</td><td>Yes</td></tr><tr><td>Is value applied verified and correct?</td><td>Yes</td></tr><tr><td>Is monitoring equipment calibrated?</td><td></td></tr><tr><td>Are QA/QC procedures defined and applied?</td><td></td></tr></table>	Data Checklist	Yes/No/NA	Title in line with methodology?	Yes	Data unit correctly expressed?	Yes	Appropriate description of parameter?	Yes	Source clearly referenced?	Yes	Description of measurement methods and procedures?	CL33	Frequency of monitoring/recording	Yes	Is value applied verified and correct?	Yes	Is monitoring equipment calibrated?		Are QA/QC procedures defined and applied?			DR I	CL33 OK	OK
Data Checklist	Yes/No/NA																								
Title in line with methodology?	Yes																								
Data unit correctly expressed?	Yes																								
Appropriate description of parameter?	Yes																								
Source clearly referenced?	Yes																								
Description of measurement methods and procedures?	CL33																								
Frequency of monitoring/recording	Yes																								
Is value applied verified and correct?	Yes																								
Is monitoring equipment calibrated?																									
Are QA/QC procedures defined and applied?																									
	Comment: CL33: The description of the parameter N <sub>x,CT</sub> is inconsistent with the monitoring manual (number of cars or % of types?).																								

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
	MM was changed → CL33 closed See VR 3.7				
3.2.2.8	<i>P</i> Total passengers transported by the project		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Description of measurement methods and procedures?	Yes			
	Frequency of monitoring/recording	Yes			
	Is value applied verified and correct?	Yes			
	Is monitoring equipment calibrated?				
	Are QA/QC procedures defined and applied?				
	Comment: See VR 3.7.				
3.2.2.9	<i>EC<sub>PJ</sub></i> Electricity consumed by MRTS (trains)		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Description of measurement methods and procedures?	Yes			
	Frequency of monitoring/recording	Yes			
	Is value applied verified and correct?	Yes			
	Is monitoring equipment calibrated?				
	Are QA/QC procedures defined and applied?				
	Comment: See VR 3.7.				
3.2.2.10	<i>N<sub>B,T</sub></i> Number of buses and taxis circulating in the city		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Description of measurement methods and procedures?	Yes			
	Frequency of monitoring/recording	Yes			
	Is value applied verified and correct?	Yes			
	Is monitoring equipment calibrated?				
	Are QA/QC procedures defined and applied?				
	Comment: See VR				
3.2.2.11	<i>OC<sub>T</sub></i> Average occupancy rate of taxis		DR I	CL31 OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
Description of measurement methods and procedures?		CL31			

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.						
	Frequency of monitoring/recording	Yes									
	Is value applied verified and correct?	Yes									
	Is monitoring equipment calibrated?										
	Are QA/QC procedures defined and applied?										
	Comment: CL31: It is not clear, how it will be assured that the measurements of NIZ, V <sub>P</sub> and OC will always be done in the same way; DOE did not get any TORs. PP answer: OC: The methodology has in its annexes TORs; this is referenced in B.7.1. where we have OC <sub>B,T</sub> → CL31 closed										
3.2.2.12	OC <sub>B</sub> Average occupancy rate of buses			DR I	CL31 OK	OK					
	Data Checklist	Yes/No/NA									
	Title in line with methodology?	Yes									
	Data unit correctly expressed?	Yes									
	Appropriate description of parameter?	Yes									
	Source clearly referenced?	Yes									
	Description of measurement methods and procedures?	CL31									
	Frequency of monitoring/recording	Yes									
	Is value applied verified and correct?	Yes									
	Is monitoring equipment calibrated?										
	Are QA/QC procedures defined and applied?										
	Comment: CL31: It is not clear how it will be assured that the measurements of NIZ, V <sub>P</sub> and OC will always be done in the same way; DOE did not get any TORs. PP answer: OC: The methodology has in its annexes TORs; this is referenced in B.7.1. where we have OC <sub>B,T</sub> → CL31 closed										
	3.2.2.13	NIZ <sub>C,T</sub> Number of cars, taxis using affected roads						DR I	CL31 OK	OK	
		Data Checklist									Yes/No/NA
Title in line with methodology?		Yes									
Data unit correctly expressed?		Yes									
Appropriate description of parameter?		Yes									
Source clearly referenced?		Yes									
Description of measurement methods and procedures?		Yes									
Frequency of monitoring/recording		Yes									
Is value applied verified and correct?		Yes									
Is monitoring equipment calibrated?											
Are QA/QC procedures defined and applied?											
Comment: CL31: It is not clear how it will be assured that the measurements of NIZ, V <sub>P</sub> and OC will always be done in the same way; DOE did not get any TORs. PP answer: NIZ needs no TORs but requires to fix locations. This is done. The baseline study which has now been referenced clearly in this parameter in B.7.1. has the sites and locations and times when the vehicle counting is done (file 43) → CL31 closed											
3.2.2.14		TDIZ <sub>C,T</sub> Distance driven by taxis and passenger cars on affected roads			DR I	OK					OK
		Data Checklist	Yes/No/NA								
	Title in line with methodology?	Yes									
	Data unit correctly expressed?	Yes									
	Appropriate description of parameter?	Yes									
	Source clearly referenced?	Yes									
	Description of measurement methods and procedures?	Yes									
	Frequency of monitoring/recording	Yes									
	Is value applied verified and correct?	Yes									
	Is monitoring equipment calibrated?										
	Are QA/QC procedures defined and applied?										

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
	Comment:				
3.2.2.15	<i>V<sub>P</sub> Vehicle project speed on affected roads</i>		DR I	CL31 OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Description of measurement methods and procedures?	CL31			
	Frequency of monitoring/recording	Yes			
	Is value applied verified and correct?	Yes			
	Is monitoring equipment calibrated?				
	Are QA/QC procedures defined and applied?				
	Comment: CL31: It is not clear how it will be assured that the measurements of NIZ, V <sub>P</sub> and OC will always be done in the same way; DOE did not get any TORs. PP answer: V <sub>B</sub> is based on moving and average speed. File 43 contains the points of measurement. Therefore, the method of measuring is irrelevant. If a 3 <sup>rd</sup> party source such as in the baseline continues to publish speed data latter will be used. → CL31 closed				
3.2.2.16	<i>BTD<sub>p,i</sub> Baseline trip distance of the cluster p of surveyed passengers using mode i</i>		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Description of measurement methods and procedures?	Yes			
	Frequency of monitoring/recording	Yes			
	Is value applied verified and correct?	Yes			
	Is monitoring equipment calibrated?				
	Are QA/QC procedures defined and applied?				
	Comment:				
3.2.2.17	<i>IPTD<sub>p,i</sub> Indirect project trip distance of the cluster p of the surveyed passengers using mode i</i>		DR I	OK	OK
	Data Checklist	Yes/No/NA			
	Title in line with methodology?	Yes			
	Data unit correctly expressed?	Yes			
	Appropriate description of parameter?	Yes			
	Source clearly referenced?	Yes			
	Description of measurement methods and procedures?	Yes			
	Frequency of monitoring/recording	Yes			
	Is value applied verified and correct?	Yes			
	Is monitoring equipment calibrated?				
	Are QA/QC procedures defined and applied?				
	Comment:				
3.2.2.18	Is the set of monitored data and parameters complete?				



	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
	Comment: Yes, complete according to ACM 0016				
<b>3.2.3</b>	<b>Monitoring plan</b>				
3.2.3.1	Are the collected data archived electronically and kept for at least 2 years after the end of the last crediting period?		NA		
	Comment:				
3.2.3.2					
	Comment:				
<b>3.3</b>	<b>CALCULATION OF BASELINE EMISSIONS, PROJECT EMISSIONS, LEAKAGE EMISSIONS AND NET GHG EMISSION REDUCTIONS AND REMOVALS</b>				
<b>3.3.1</b>	<b>Baseline emissions</b>				
	Is the survey conducted according to annex 4 of the methodology?		DR	CL26 CL27 OK	OK
3.3.1.1	Comment: A test survey with around 700 samples was done for the existing line 1 since the extension is not yet in operation. CL26: Please send 30 samples of the survey as a random sample to the validator. PP: The samples with the requested numbers were scanned and sent. The local expert examined them and found no errors. → CL26 closed CL27: The description and source of the test survey are not or not clearly enough mentioned in the PDD. PP answer: Annex 3 details have been added. → CL27 closed				
3.3.1.2	Are the procedures to derive a sample size adequate to get the required level of precision (annex 4)?		NA		
	Comment: Not applicable, since the new metro line is not yet operational.				
3.3.1.3	Was the baseline emission per surveyed passenger correctly calculated according to the equations in the methodology?		DR	OK	OK
	Comment: Yes, from the test survey				
3.3.1.4	Were the total baseline emissions correctly calculated according to the equations in the methodology?		DR	OK	OK
	Comment: Yes, from the test survey				
3.3.1.5	Was the lower limit of the 95% confidence interval used to calculate the final total baseline emissions?		DR	OK	OK
	Comment: Yes				
3.3.1.6	Were the different equations of the methodology applied correctly to calculate the intermediate parameters for the final calculation of baseline emissions?		DR	OK	OK
	Comment: Yes				
3.3.1.7	Are the relevant vehicle categories chosen according to the methodology?		DR	OK	OK

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
	Comment: Yes				
3.3.1.8	Is a technology improvement factor used to take care of continuous improvement?		DR	OK	OK
	Comment: 0.99 per year according to ACM0016				
3.3.1.9	Are the final total baseline emissions covering the entire emissions which would have been caused by the project passengers in absence of the project from his trip origin to his trip destination?		DR	OK	OK
	Comment: Yes				
3.3.1.10	How are the different distances calculated and is the procedure reliable?		DR	OK	OK
	Comment: Test survey, 30 random samples were controlled by the local expert, no error was found.				
<b>3.3.2</b>	<b>Project emissions</b>				
3.3.2.1	Are the direct project emissions calculated according to the methodology?		DR	OK	OK
	Comment: Yes, but see CL36				
3.3.2.2	In case of electricity use in rail based MRTS is only the propulsion energy included in the consumption?		DR	OK	OK
	Comment: Yes for the estimation of ex-ante emissions				
3.3.2.3	Was the survey for determining indirect project emissions conducted according to annex 4 of the methodology?		DR	OK	OK
	Comment: Yes				
3.3.2.4	Are the procedures to derive a sample size adequate to get the required level of precision (annex 4)?		NA		
	Comment: Not yet the real survey				
3.3.2.5	Are the indirect project emissions per passenger calculated according to the methodology?		DR	OK	OK
	Comment: Yes, for the test survey				
3.3.2.6	Were the total indirect project emissions calculated according to the methodology?		DR	OK	OK
	Comment: Yes				
3.3.2.7	Was the upper limit of the 95% confidence interval used to calculate the final total indirect project emissions?		DR	OK	OK
	Comment: Yes				
3.3.2.8	Are the final total project emissions plausible and conservative?		DR	OK	OK

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
	Comment: Yes for the ex-ante estimation of project emissions				
<b>3.3.3</b>	<b>Leakage emissions</b>				
3.3.3.1	Are the sources of leakage emissions complete according to the methodology?		DR	OK	OK
	Comment: Yes, but no leakage applied for ex-ante emission estimation				
3.3.3.2	Are leakage emissions due to change of load factors of buses and taxis calculated according to the methodology?		DR	OK	OK
	Comment: Yes				
3.3.3.3	Are load factors of buses and taxis monitored in the years 1, 4, 7 (and 10) and according to the methodology (annex 1, 2, 3)?		DR	OK	OK
	Comment: Foreseen in monitoring manual				
3.3.3.4	Are leakage emissions due to reduced congestion and rebound effects calculated according to the methodology?		DR	OK	OK
	Comment: Yes, but no leakage applied for the ex-ante emission estimation				
3.3.3.5	Are the affected roads identified according to the methodology and clearly listed in the PDD?		DR	OK	OK
	Comment: Yes PDD Map 4 (just one affected road)				
3.3.3.6	Are the vehicle speeds on the affected roads monitored annually?		DR	OK	OK
	Comment: Yes PDD B.7.1				
3.3.3.7	Are the leakage emissions due to changes in vehicle speed calculated according to the methodology?		DR	OK	OK
	Comment: Yes, but no leakage applied for the ex-ante emission estimation.				
3.3.3.8	Do the visible speeds on some affected roads correspond to those encountered during the site visit?		I	OK	OK
	Comment: Affected road is from Dadae Beach to Goejeong Intersection, the average circulating speed is 25 km/h, which seems reasonable after visiting parts of the construction sites and of the affected road.				
<b>3.3.4</b>	<b>Emission reductions</b>				
3.3.4.1	Are emission reductions calculated according to the methodology?		DR	OK	OK
	Comment: Yes ACM 0016				
3.3.4.2	Is leakage with values < 0 excluded from the calculation of emission reductions?		DR	OK	OK
	Comment: No leakage was applied for ex-ante estimation				
3.3.4.3	Was a sensitivity analysis carried out according to the methodology (5% emission reduction)?		DR	OK	OK

	Requirement	Ref.	MoV	Draft Concl.	Final Concl.
	Comment: Table A5 PDD, only passenger numbers and metro electricity consumption are sensitive				
3.3.4.4	Are the sensitive parameters discussed in the PDD and is it ensured that the appropriate value is correct and conservative?		DR	OK	OK
	Comment: Yes				
3.3.4.5	Are net GHG emission reductions plausible?		DR	CL5 OK	OK
	Comment: Yes, the PDD tables give a good estimate of emission reductions				

## Protocol 4: Summary of Requests

No.:	CL 1	Reference:	VVM 44: Letter of Approval
Validator request:	Letters of Approval have not yet been submitted		
Project owner response:	Only 1 LoA (from Korea) is required. To get the LOA the draft validation report is required.		
Validator conclusion:	LoA from the Republic of Korea received on 18/07/2012, CL1 closed	Date:	18/07/2012

No.:	CL 2	Reference:	MoC
Validator request:	The MoC document of the project has not yet been submitted.		
Project owner response:	Attached		
Validator conclusion:	Form F-CDM-MOC was used, OK, CL2 closed	Date:	25/04/2012

No.:	CL 3	Reference:	PDD A.4.1.4
Validator request:	The geographical coordinates are not written in the correct format (x,yyy °) and are not representing the headquarter of BTC.		
Project owner response:	Has been added and HQ has been inserted for geo-coordinates		
Validator conclusion:	Correct format, CL3 closed	Date:	25/04/2012

No.:	CL 4	Reference:	PDD A.2 Description of the project
Validator request:	Insufficient information about the organization between the city and the transportation corporation		
Project owner response:	More information has been added in Section A.2.		
Validator conclusion:	Busan Transportation Corporation was created in accordance with the "Local Public Organizations Act" with the purpose of promoting public transport facilities and the welfare of citizens of Busan. Some more has been added to the PDD. CL4 closed OK	Date:	27/04/2012

No.:	CL 5	Reference:	PDD A.2 Description of the project
Validator request:	The context between a "larger urban zone LUZ" and the "metropolitan area of Busan" is not defined clearly enough.		
Project owner response:	Has been detailed.		
Validator conclusion:	An explanatory sentence was added in chapter A2 of the PDD, CL5 closed.	Date:	25/04/2012

No.:	CL 6	Reference:	PDD A.4.3 (pre project situation)
Validator request:	There are no motorized rickshaws and there are more than 2 MRTS.		
Project owner response:	Rickshaws has been corrected MRTs lines has been corrected.		

Validator conclusion:	PDD adapted, CL6 closed	Date:	25/04/2012
No.:	CL 7	Reference:	PDD A.4.3 (Figure 1)
Validator request:	It is not clear why there is only data up to 2006.		
Project owner response:	Data is until 2009. No newer data than 2009 was available (the report was issued in 2010)		
Validator conclusion:	Explanation is satisfying, CL7 closed	Date:	25/04/2012

No.:	CL 8	Reference:	PDD A.4.3 (pre project situation)
Validator request:	It is not clear in which dimension the modal split rates are measured (passenger-rides, passenger*km, other?).		
Project owner response:	Passenger rides as is usual. Has been corrected		
Validator conclusion:	Figure 1 in PDD has been amended. CL8 closed	Date:	27/04/2012

No.:	CL 9	Reference:	PDD A.4.5 and B.5 table 7
Validator request:	There is insufficient information about the nature of the financing by the city government. Is it a private or a government financing?		
Project owner response:	As indicated in chapter B5 step 2 60% is financed by central government. 40% are financed by the City. This has been clarified. Table 7 clearly indicates Finance by Central Gov. and Finance by Municipality i.e. City of Busan. Section A.4.5. refers to public funding through ODA of an Annex I country. This is not the case as funds are from Korea. The 1 <sup>st</sup> sentence in A.4.5. has been deleted as wrong.		
Validator conclusion:	A.4.5. in PDD was corrected. CL9 closed	Date:	28/04/2012

No.:	CL 10	Reference:	PDD B.2 table 2
Validator request:	There is insufficient information about how the bus system is planned to be restructurized.		
Project owner response:	As explained with the line 3 and line 4 as a sample, once the construction has finished the feasibility study will be realized for reform of the bus routes for Dadae line. Please refer to excel sheet line 3 and 4 of file 54. More information has been added to the PDD.		
Validator conclusion:	The following sentences were added to the PDD: "The same procedure was followed by the former phased opening of the Busan metro lines 3 and 4. In Line 3 15 routes of buses were closed, 4 routes were changed in their routing and 2 routes changed the frequency of bus operations, while also 5 new routes were introduced to optimize integrated public transit. In Line 4 overlapping bus routes were changed including route revoking and frequency changes." CL10 closed, OK		
		Date:	25/04/2012

No.:	CL 11	Reference:	PDD B.2 table 2
Validator request:	There is insufficient information about the possible actual and future use of biofuels for buses. Specifically, it is not clear: - whether there is actually no use of biofuels for buses - what will happen to the project if in future the use of some biofuel would become mandatory for some motorized vehicles procedures.		
Project owner response:	2% bio-fuel blend is used since 1/2012. See confirmation letter of public transportation system File 57. The CER spreadsheet and the PDD have been adjusted. If in the future a different blend of bio-fuel is used this is monitored and the BEF is adjusted (see p. 10 of the methodology and p. 29 of the methodology). For clarification this has been added also section B.7.1. Parameter EF <sub>CO2</sub>		

Validator conclusion:	PDD tables [76] were corrected with the new biofuel blend of 2%. The PDD was amended only partly since the summary table in B.6.2 uses still the old values.	Date:	25/04/2012
Project owner response:	The corrections have been made in PDD v1.2 of 25.04.2012	Date:	25/04/2012
Validator conclusion:	New PDD amended [75] CL11 closed	Date:	25/04/2012

No.:	CL 12	Reference:	PDD B2 map 3
Validator request:	Map 3 is not fully understandable, some explanations are missing.		
Project owner response:	A new map has been included in the PDD		
Validator conclusion:	The new map is better understandable, CL12 closed	Date:	25/04/2012

No.:	CL 13	Reference:	PDD B.4 Baseline identification, step 1
Validator request:	The mentioned feasibility reports are not included in the PDD as a document		
Project owner response:	The sentence has been deleted and replaced.		
Validator conclusion:	PDD adapted, OK, CL13 closed	Date:	25/04/2012

No.:	CL 14	Reference:	PDD B.4 Alternative 4
Validator request:	As a proof for a decreasing share of public transit, file 24 is mentioned. The data in table 12 p.28 are rather old (1979 ... 1996) and were collected for Seoul.		
Project owner response:	Has been changed to File 20 which is for Busan and which has data until 2009		
Validator conclusion:	The footnote 15 has been changed, the data come now from the "2010 Busan statistical yearbook" with database ending by 2009. CL14 closed	Date:	25/04/2012

No.:	CL 15	Reference:	PDD B.5 prior consideration
Validator request:	The acknowledgment of the prior consideration form by the Korean DNA is documented with a respective letter of 2011. The dates there and in the PDD and in the form are not the same everywhere; the letter is not a listed document.		
Project owner response:	See File 61 which has also been referenced in PDD		
Validator conclusion:	The amendment of the PDD is OK. There are still several confusing dates regarding prior consideration: Submission date in the PDD is 02.12.2009, submission date in the prior consideration form (file 33) is 30.11.2009; the acknowledgement by the DNA (file 61) shows a document date of 16.12.2009, a date in the Korean text again of 2009.12.16 with a number of 2463, a date in the translation of 2009.12.03 and a corresponding number of 2365. Please explain.		
		Date:	27/04/2012
Project owner response:	File 31: The date in the UNFCCC template is filled out by the PP (30.11.2009) and thus not the relevant proof date. The relevant proof date used in the PDD is the one as published on the UNFCCC website as document received: <a href="http://cdm.unfccc.int/Projects/PriorCDM/notifications/index_html">http://cdm.unfccc.int/Projects/PriorCDM/notifications/index_html</a> This date is 02/12/2009 File 61: has as date 16.12.2009 (date of confirmation of reception of document). The translation was wrong and has been corrected (see new file 61). The PDD for reception of the Korean DNA of prior consideration has also been changed to the date 16.12.2009.		

Validator conclusion: Explanation and amendment of file Date: 28/04/2012  
61 [62] OK. CL15 closed.

No.:	CL 16	Reference:	PDD B.5 table 5
Validator request:	The passenger numbers for Busan metro lines 1 to 3 date back to the years 2001 and 2006. Newer data are certainly available.		
Project owner response:	Table 5 compares projections with actual values of passengers for various cities and is based on a report realized by an university. The critical issue is thereby not to have the most recent data but to compare projections and actual data. Important is thus to have projection and actual data year coincide e.g. 2001 and 2006 as made by the report. Projections are often made with 5-year gaps between years and therefore not for all years also projections are available. But as mentioned the critical issue is not if the year is very recent but that projection year and actual year are the same as made by the study.		
Validator conclusion:	Explanation is accepted. OK. CL16 closed.	Date:	28/04/2012

No.:	CL 17	Reference:	PDD B.5 table 7 and file 34
Validator request:	There is insufficient information about the calculation of the operational costs like additional drivers, additional mechanics and maintenance costs, additional administrative costs, and others.		
Project owner response:	File 36b has added details on how these costs were estimated as well as the cost components. File 36 is the FSR used for all finance.		
Validator conclusion:	The detailed analysis raised some more questions: 1) The labor costs per person and year in Busan are around 14% higher than in Incheon. 2) The operational costs in Busan per passenger are around 0.7 US\$, compared to the other cities in Korea up to 3.7 times more. Please explain.		
	Date: 26/04/2012		
Project owner response:	<p>1. Labor Costs for both cities are based on what is actually paid in the already existing metro in each city. A difference of 14% between cities and between different employers does not seem unrealistic especially as the data is not based on fantasy data but based on what the current salaries in the existing systems are (Incheon as well as Busan already operate a metro line). Price comparison data show e.g. that median salaries between cities fluctuate by more than 15% or e.g. show comparing Busan with Incheon that a sqm in the city centre of Busan costs nearly 14,000 USD but only USD 2,000 in Incheon (see <a href="http://www.numbeo.com/cost-of-living/country_result.jsp?country=South+Korea">http://www.numbeo.com/cost-of-living/country_result.jsp?country=South+Korea</a>). Thus summarized the difference seems in itself normal and on the other hand the data for both cities is based on actual experience.</p> <p>2. Busan is not an entire metro line but only an extension of a metro line with 6 stations and not a full metro line. The end parts of any public transit system always have less passengers than the central parts reflected in the relatively low passenger numbers of the CDM project. Operational costs are however the same for stations with low or with high passenger affluence as the trains run on the entire line and have to operate in a configuration and frequency in accordance with the max demand on the line. This fact can be seen if we list the Get-On plus transit passengers from station 106 (last) to 101 (first of CDM):</p> <p>106: 4,645 105: 9,392 104: 11,829 103: 14,985 102: 16,991 101: 16,931</p>		



In the reverse direction exactly the same: 106: 5,094

105: 10,350

104: 12,637

103: 15,481

102: 17,156

101: 17,460

One can see that only in stations 101 and 102 the demand gets stable whilst before it is much less with the last station having 1/4 of the stable amount in 101 ff (see for data File 14)

Additionally the distance between stations tends to be higher the more the line is in the outskirts thus again increasing costs per passenger. The metro extension is 8km with 6 stations i.e. 1.34km on average between stations while the existing line 1 has 32.5km with 34 stations i.e. 0.956km between stations i.e. the extension has 40% more space between stations increasing costs.

For these two reasons it makes no sense to compare costs per passenger for line extensions against full metro systems.

Validator conclusion:	The explanation is reasonable, OK. CL17 closed.	Date:	27/04/2012
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No.:	CL 18	Reference:	PDD B.5 table 7 and finance details, file 34
Validator request:	There is intransparent information about the calculation of the revenues (fare box, other income). The figures cannot be reproduced from primary data.		
Project owner response:	File 36c has added details on how fare box and non-fare-box revenue are estimated. File 36 is the FSR used for all finance.		
Validator conclusion:	File 37c (there is no file 36c) gave some more information about fare-box revenues, but probably there is a translation error in table 8-6, where it should read 100 million/year and not Million/year. OK. CL18 closed.		
		Date:	26/04/2012

No.:	CL 19	Reference:	PDD B.5 table 7 and finance file
Validator request:	There is insufficient information about the choice of the ticket prices. It is specifically not clear why the price should remain constant over the entire period.		
Project owner response:	<p>The NPV is calculated based on constant WONs. Therefore inflation is not included in any revenue, investment or cost estimate.</p> <p>The full fare rate of 1100 Won used corresponds to the metro Busan fare for 1 section cash as charged 2009 (since 1.2011 the full fare rate if paying by Transportation card is for 1 section 1100). The metro extension part of the project is only 1 section.</p> <p>See <a href="http://english.busan.go.kr/07community/01_01.jsp?command=view&amp;page=0&amp;nowBlock=0&amp;board_code=8&amp;d_code=01_01&amp;sn=1560">http://english.busan.go.kr/07community/01_01.jsp?command=view&amp;page=0&amp;nowBlock=0&amp;board_code=8&amp;d_code=01_01&amp;sn=1560</a></p>		
Validator conclusion:	The ticket price was taken as 1 100 WON in all calculations; it was increased the last time by 01/12/2011. OK. CL19 closed.	Date:	26/04/2012

No.:	CL 20	Reference:	PDD B.5 table 7 and especially file 34
Validator request:	File 34 shows expenditures for construction and land acquisition already in the years 2006-2008. A newer document "Construction Proceeding Status, of February 2012" shows the comparison between real and expected costs. It is not clear why this newer document was not used for the establishment of the financial analysis since otherwise it could lead to a contradiction with prior considerations of CDM revenues. At least an explanation for the planned and later realized expenditures should be given.		
Project owner response:	<p>The data is based on the FSR dated 2008 prior taking an investment decision on the metro. Land used potentially by the metro, which was property of the Municipality, was valued at the price as of 2008. Data years of the FSR do not coincide with actual investment years, as there has been some delay. Major investment (construction, trains) in the FSR is for 2009-2013 whilst the first construction contract was only signed 11/2009 and construction and thus major expenses only started thereafter i.e. 2010.</p> <p>As of GUIDELINES ON THE ASSESSMENT OF INVESTMENT ANALYSIS EB 62 Annex 5 point 6 "Input values used in all investment analysis should be valid and applicable at the time of the investment decision taken by the project participant". This needs to be prior project starting date as defined by the EB. The date of investment decision is 09/2009. The project starting date is the signature of the first construction contract being 04/11/2009. Therefore data of 2/2012 cannot be used in the financial assessment, as all data has to have been available prior 9/2009. Also 2/12 data is only on partial investment and thus a meaningful comparison of actual and expected costs cannot yet be made as the investment is fully ongoing and some parts might be more and others less advanced than projected in the original FSR per annum.</p>		
Validator conclusion:	The explanation is correct; the proof for the timely expenditures is given with the mentioned document of February 2012, which indeed cannot be used for the financial assessment. OK. CL20 closed.	Date:	26/04/2012

No.:	CL 21	Reference:	PDD A4.4, tables 11, 12 and tables in Annex 3
Validator request:	It is not clear why the crediting period starts already in 2014 since the expected starting date of the new extension is thought to be in the end of 2014.		
Project owner response:	The operational start was projected to be 1.2014 (see FSR) and therefore the crediting period is also put as of this date. As explained in the former CAR in fact the construction start has around 1 year delay. This delay might potentially be caught up. If the project continues with the current delays the operational start will be end and not early 2014. In this case the crediting period will be changed after registration based on actual operational starting date		
Validator conclusion:	SQS agrees with this explanation that the starting date of the first 7-year period will be the 01/01/2014 or based on the actual operational starting date. CL21 closed	Date:	25/04/2012

No.:	CL 22	Reference:	PDD p. 24
Validator request:	There is an addition in the last sentence of this page missing: "...in absence of CDM..."		
Project owner response:	Sentence has been added		
Validator conclusion:	PDD adapted, OK, CL22 closed	Date:	25/04/2012

No.:	CL 23	Reference:	PDD B.5 table 9
Validator request:	It is not clear whether some of the Metropolitan Areas having a Metro have constructed their Metro(s) including the CDM.		
Project owner response:	For current metros no; sentence has been added.		
Validator conclusion:	The following sentence was added below table 9 in the PDD: No city has as of GSC start a registered CDM MRTS project. Seoul metro line 9 is a registered VCS project. Daegu, Incheon as well as Busan are in the process of CDM validation for their new metro lines. CL23 closed.OK	Date:	26/04/2012

No.:	CL 24	Reference:	PDD B.5 map 4
Validator request:	The non-project points in the map are confusing. The mark for the affected road does not show the entire road.		
Project owner response:	The map has been replaced		
Validator conclusion:	New map is much clearer, OK, CL24 closed	Date:	25/04/2012

No.:	CL 25	Reference:	PDD B.6.2 p.44
Validator request:	It is not clear why the value for the TDL (1.67%) was chosen just only from 1 year (and not 3 years as the grid emission factor).		
Project owner response:	The grid emission factor is based on how to calculate the CM, which is based on a 3-year average of the OM (not the BM). This is irrelevant for TDL. TDL is based on the most recent available year. This is in accordance with the EB Tool to calculate baseline, project and/or leakage emissions from electricity consumption section "Data and Parameters Monitored" which also states annual data (annual monitoring)		
Validator conclusion:	OK, explanation accepted, CL25 closed	Date:	28/04/2012

No.:	CL 26	Reference:	PDD B.6.3 and table A1
Validator request:	Please send the following samples out of the survey together with a translation pattern to the validator: 2, 10, 102, 121, 130, 197, 202, 221, 230, 302, 321, 330, 369, 402, 404, 421, 421, 430, 502, 504, 521, 530, 542, 602, 604, 621, 630, 702, 704, 730		
Project owner response:	See file survey translation and file surveys scanned		
Validator conclusion:	The samples were reviewed by the local expert and are correct. CL26 closed	Date:	28/04/2012

No.:	CL 27	Reference:	PDD B.6.3 and Annex 3
Validator request:	The description and source of the test survey (PDD tables) are not or not clearly enough mentioned (e.g. table A1).		
Project owner response:	Annex 3 details have been added. Section B.6.3. is not related to the survey		
Validator conclusion:	The explanation has been added. CL27 closed	Date:	28/04/2012

No.:	CL 28	Reference:	PDD p. 52, table 14
Validator request:	It is not clear how the electricity consumption ex-ante of the project was estimated.		
Project owner response:	The project is an extension of an operating metro line. The projections have therefore been based on the operating lines train electricity consumption per passenger as explained in B.6.2.		
Validator conclusion:	Explanation OK. CL28 closed	Date:	28/04/2012

No.:	CL 29	Reference:	PDD p. 37
Validator request:	There is no <b>table</b> with the measured circulating speed.		
Project owner response:	The sentence has been deleted. It is only 1 affected road and the speed of that road is included in the sentence thus no need for a table		
Validator conclusion:	Amendment of PDD OK. CL29 closed	Date:	25/04/2012

No.:	CL 30	Reference:	PDD B 6.3 and Annex 3 table A5
Validator request:	Passenger numbers for the extension come from the feasibility study. However; it is not clear how these passenger numbers were estimated and if they are conservative.		
Project owner response:	See File 37c.		
Validator conclusion:	There is a slight difference between passengers used for calculating revenues (file 37c) and the passengers in file 14 used for calculating emission reductions, why? It is still not clear on which base the passenger numbers in the feasibility study were estimated.		
	Date: 28/04/2012		
Project owner response:	File 14 is based on daily data while File 37c has differentiated daily data between peak and off-peak season and has then multiplied with a factor for peak and off-peak. In the FSR of File 14 this differentiation is not made. The demand estimation is based on the existing line. The project is only an extension of a metro line and thus demand estimates are based primarily on the existing line and origin-destination surveys of passengers using the metro line 1.		
Validator conclusion:	The answer for the difference between file 14 and file 37c is correct, but it does not explain, why two different numbers are used for income- and reduction-calculations. The explanation for the feasibility study is clear.		
	Date: 29/04/2012		

Project owner response:	File 14 had been calculated by the PD. File 37c data has been taken for passenger estimates per annum and the PDD as well as CER sheet have been adapted. See also new files 37c and 14	Date:	30/04/2012
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Validator conclusion:	Adaption of PDD [75] and PDD tables Busan [76], which resulted in around 7.5% lower emission reductions. New files 37c [72] and 14 [71]. CL30 closed	Date:	02/05/2012
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No.:	CL 31	Reference:	PDD B.7.1 page 53/54
Validator request:	It is not clear how it will be assured that the measurements of NIZ, V <sub>P</sub> and OC will always be done in the same way. DOE did not get any TORs.		
Project owner response:	V <sub>B</sub> is based on moving and average speed. File 43 contains the points of measurement. Therefore the method of measuring is irrelevant. If an 3 <sup>rd</sup> party source such as in the baseline continues to publish speed data latter will be used. OC: The methodology has in its annexes TORs. This is referenced in B.7.1. where we have OC <sub>B,T</sub> . NIZ needs no TORs but requires to fix locations. This is done. The baseline study, which has now been referenced clearly in this parameter in B.7.1. has the sites and locations and times when the vehicle counting is done (File 43)		
Validator conclusion:	OK, explanation is adequate. CL31 closed.	Date:	26/04/2012

No.:	CL 32	Reference:	PDD D.2
Validator request:	It is not clear whether the project complies with all legal requirements. There is insufficient information about the requirements stated and about official approval that these requirements are met. The metro act is not mentioned.		
Project owner response:	See all approvals in File 58. The PDD has been amended in section D2		
Validator conclusion:	There seems to be a printing error in the PDD, section D.2, where Daegu Metro line 3 is mentioned instead of Busan Metro Line 1, Dadae. File 58 states that the city of Busan and the Minister of Land transportation and maritime affair require the fulfillment of all reduction measures mentioned in the EIA. Open	Date:	28/04/2012
Project owner response:	PDD version 1.4 of 30/04/2012 corrected under D.2.,	Date:	30/04/2012
Validator conclusion:	Correction OK, CL32 closed	Date:	20/06/2012

No.:	CL 33	Reference:	PDD B.7.2 Monitoring manual
Validator request:	It is not clear after the discussion during the on-site visit if Grütter Consulting AG is really responsible for the monitoring reports of the whole crediting period since they are no more project participants.		
Project owner response:	GC is NOT responsible. The PDD and the MM have been clarified.		
Validator conclusion:	New version of MM and PDD are adapted. OK. CL33 closed.	Date:	26/04/2012

No.:	CL 34	Reference:	PDD B.7.1 page 50
Validator request:	The description of the parameter $N_{x,CT}$ is inconsistent with the monitoring manual (number of cars or % of types?).		
Project owner response:	The MM has been corrected. See version 1.1		
Validator conclusion:	Correction of MM is OK. CL34 closed.	Date:	26/04/2012

No.:	CL 35	Reference:	PDD B.7.1 page 52
Validator request:	It is not clear whether the electricity meters will be calibrated by an officially accredited organization.		
Project owner response:	According to government regulations the electricity meters (depending on the type) are calibrated every 7-10 years. This is for total electricity consumption. The electricity meters are from KEPCO and managed by KEPCO and not the metro. Therefore the metro i.e. the PP does not calibrate the meters because it does not have the competence to do this. The PDD has been amended. See also file 59 and 60.		
Validator conclusion:	OK but see also CL36. CL35 closed.	Date:	26/04/2012

No.:	CL 36	Reference:	PDD B.7.1 page 52
Validator request:	It is not clear how the electricity consumed will really be measured. There are measurements at the substations (22.9 kV), which can be checked with the bills. The electricity consumption of the traction, however, is measured at 1500 V DC. In between, there are other consumptions and losses.		
Project owner response:	See File 60 and changes in PDD		
Validator conclusion:	There is probably a printing error in the PDD p58 at Data/Parameter $EC_{PJ}$ , where under QA/QC the electricity meters are said not to be owned by <b>Daegu Metropolitan Transit Corporation</b> . Please correct, when necessary. Furthermore, file 60 shows the monthly invoice, which is based on KEPCO's measurements at Nopo Substation at 22.9kV. The relation between the invoice and the measurement of the traction energy at 1500V is not yet clear or with other words, it is not yet clear how the losses for the transformers and rectifiers will be divided up. Date: 28.04.2012		
Project owner response:	PDD under B.7.1 was corrected. The control with the electricity invoice is for the total. Electricity consumption is based on the substation for traction.	Date:	05/07/2012
Validator conclusion:	Amendment and explanation OK. CL36 closed	Date:	06/07/2012

No.:	CL 37	Reference:	PDD B.7.1 and Annex 4 and monitoring manual
Validator request:	It is not clear how the check of internal consistency of the survey (using Cronbachs Alpha) will be performed. Specifically, it is not clear which items will be chosen for the calculation of the sub-variances.		
Project owner response:	Cronbach is used to test the consistency of results between the 2 measurements in different times as proxy regarding the internal consistency of the survey. The consistency is		



	checked within the same unit of analysis, which corresponds to the metro station. The average emissions per metro station are checked between the 2 surveys. If the emission levels of the same station between the two measurements are highly correlated this implies the correlation and consistency of the main items of the survey with latter being modes of transit and distance per mode.	
Validator conclusion:	The explanation is correct and will be adapted for the verification surveys. CL37 closed.	Date: 28/04/2012

No.:	CL 38	Reference: PDD and monitoring manual
Validator request:	The project titles are not through out the documents identical.	
Project owner response:	MM has been amended	
Validator conclusion:	Now consistent, OK, CL38 closed	Date: 25/04/2012

No.:	CL 39	Reference: PDD A 4.1.4
Validator request:	The common practice analysis is not yet clear since the expression LUZ (larger urban zone) according to the methodology exists only in Europe. It should, therefore, be defined or transferred to the situation in the Republic of Korea.	
Project owner response:	Common practice analysis has been made clearer by assessing relation LUZ to common city population definition based on European cities and transferring that relation to Korean cities.	
Validator conclusion:	According to the local expert the name of Jeonbuk (name of province) should be changed in Jeonju (name of city)	Date: 20/06/2012
Project owner response:	Jeonju is been taken. The PDD has been adapted. See Files 26a and 26b for more details.	
Validator conclusion:	PDD was adapted, new files included, CL39 closed.	Date: 26/06/2012

No.:	CAR 1	Reference: PDD table 6
Validator request:	According to file 34 there is a salvage value of 329 x 100 million WON for land	
Project owner response:	The full value (100%) has been included as salvage value as explained in the PDD as well as the Finance file	
Validator conclusion:	Salvage value is included, OK. CAR1 closed.	Date: 26/04/2012

No.:	FAR 1	Reference: PDD B.6.2 / B.7.1 and monitoring plan
Validator request:	Before the start of the metro, the parameters $OC_{B,T}$ , $NIZ_{C,T}$ and $V_P$ have to be measured with a survey performed in accordance with the TOR in order to have their reliable values for the comparison with the later surveys.	
Project owner response:	No. OC, NIZ and VB are, in accordance with the methodology, parameters available prior validation and therefore in B.6.2. They are thereafter monitored to determine leakage once the project is operational as listed in B.7.1. Baseline factors will however NOT be determined a 2 <sup>nd</sup> time prior project start.	
Validator conclusion:	The answer corresponds to the methodology and the validators. FAR 1 is closed.	Date: 28/04/2012