CLEAN DEVELOPMENT MECHANISM
PROPOSED NEW METHODOLOGY: MONITORING (CDM-NMM)
Version 01 - in effect as of: 1 July 2004

CONTENTS

A. Identification of methodology

B. Proposed new monitoring methodology

SECTION A. Identification of methodology

A.1. Title of the proposed methodology:

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Title: Specific consumption rate projection for demand-side brewery energy saving processes

Version: 5.0

Date: 30/05/2005

A.2. List of category(ies) of project activity to which the methodology may apply:

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Energy Efficiency Improvement Project
[Demand-side energy efficiency programs for specific technologies]

A.3. Conditions under which the methodology is applicable to CDM project activities:

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The methodology is applied to the CDM project, which installs integrated high energy efficient system in the beer brewery production process in the existing factory.

The applicability conditions of this methodology are as follows:

[Note] Boxes are just for the explanation of the condition.

Condition 1:

The project is to install energy saving systems (*incl*. in-house heat and/or power generation) in the existing production process if it does not result in new production facility with separate/new energy utility system.

[**Explanation**] The brewery may increase its production capacity gradually in order to meet growing demand in the country, in general. The CDM project contributes *only* to demand-side energy efficiency improvement, even though the beer production capacity increases simultaneously. This is the fundamental difference between the energy saving projects (in energy *supply* industry sector) which expand the amount of output driven by such a project simultaneously (*i.e.*, the output and the target to save are common in the energy sector, while for the beer brewery

sector energy saving project, energy saving and beer production is *independent* theoretically as the energy is only a *utility*). See ANNEX for real situation of the beer factories.

Condition 2:

The project does not set its crediting period beyond the physical lifetime of the existing utility system.

[**Explanation**] The baseline scenario may be changed beyond the lifetime of the existing energy utility system.

Condition 3:

The project includes biogas recovery and its utilization for boiler in the system

[**Explanation**] This condition reflects an aspect that the project installs "integrated" system to use energy efficiently. In addition, this condition ensures that no methane is emitted from the effluent wastewater in the project scenario.

Condition 4:

Integrated up-to-date technology (*e.g.*, VRC[1] system, high refrigeration efficiency, ice thermal storage system, energy-efficient operation of pasteurizer, and biogas-boiler) for energy conservation is not installed at the factory now and not commonly installed in the host country beer brewery sector [*i.e.*, lack of experience and knowledge]. In order to assess this Condition 4, the DOE (validator) is going to assess the situations below (it is not necessary to meet all situations). The DOE may request the project participants to provide other materials to support this Condition 4.

- Lack of integrated up-to-date technology above in the host country, with a penetration rate less than 10%;
- The decision making processes of enterprises in the host country on investment places low priority on energy conservation because of little knowledge of the technical and financial aspects of energy efficiency and/or setting priority on investment for increasing beer production than for energy saving (within the limited financial resources);

Condition 5:

Reduction of energy costs by the project (through energy saving) is not the most economically attractive course of action to invest without CER revenue. The project participants shall demonstrate its rationale by providing related information to the DOE (validator). "Investment analysis" method in the "Tool for the demonstration and assessment of additionality" is applied.

[1] Vapor Recovery Compressor system (a core heat pump technology). This technology is usually the core part of the integrated highly efficient energy utility system in the brewery factory.

Condition 6:

The grid electricity displaced effect by the project is small enough to neglect build margin component in comparison with the capacity of the grid. The project participants shall confirm this by interviewing person(s) responsible for the grid power development plan.

Other conditions which are specific for the monitoring methodology are not needed.

A.4. What are the potential strengths and weaknesses of this proposed new methodology?

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The monitoring methodology avoids using the default values and measure the parameters as much as possible to obtain more accurate values.

SECTION B. Proposed new monitoring methodology

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B.1. Brief description of the new methodology:

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The monitoring methodology consists of two parts:

a. Monitoring to estimate energy-saving based CO_2 emission reductions, and

b. Monitoring of lagoon CH_4 emission reductions.

For energy saving part, precise monthly data for beer production, energy consumption by source are measured to estimate emission reductions not only after implementation but also before implementation of the project for more precise estimation of the counter-factual baseline emissions specified in the baseline methodology.

For lagoon CH_4 emissions (in the baseline scenario), sampling (before implementation of the project) is used with adjustment by organic waste measured afterwards.

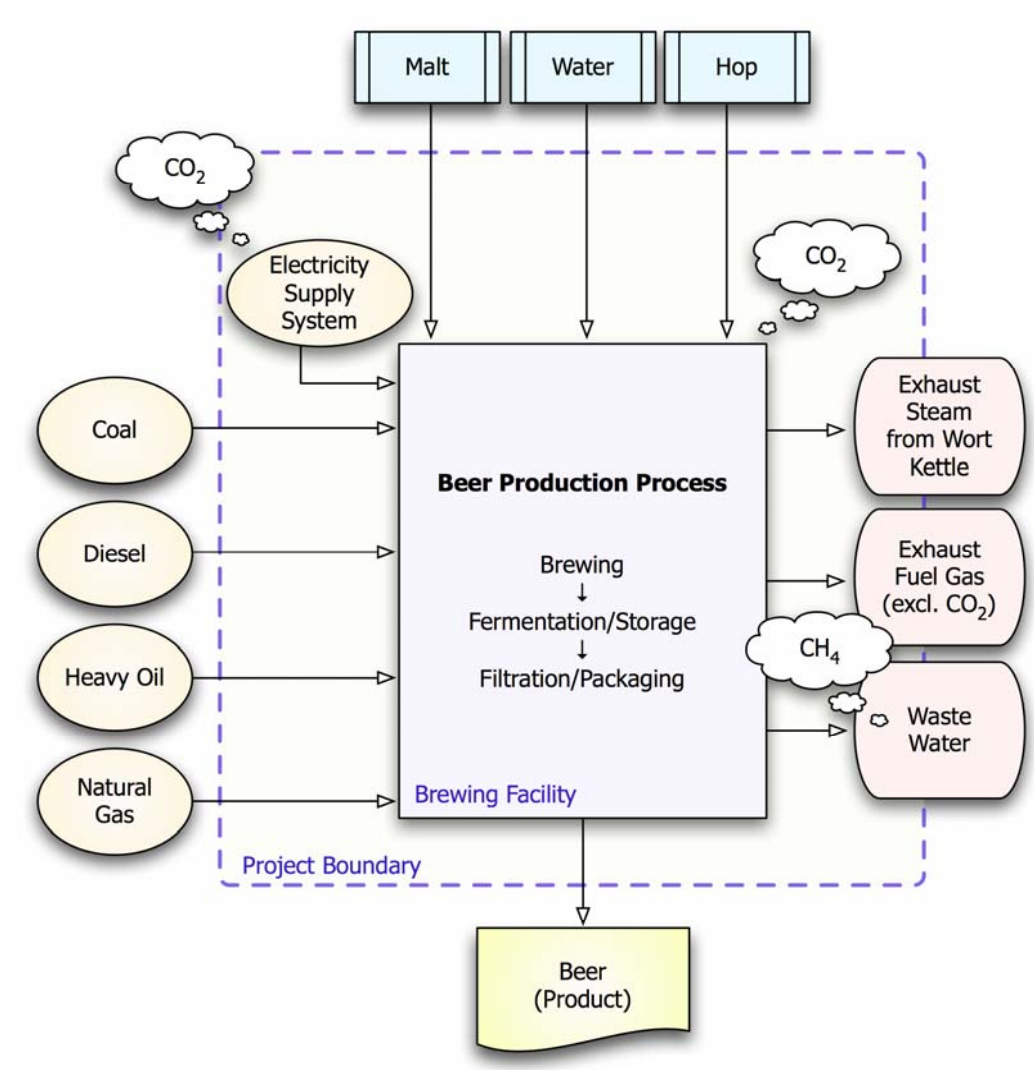

Figure NMM-1: Project Boundary for Brewery Plant Energy Conservation Project

B.2. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario:

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B.2.1. Data to be collected or used in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
P0-e-i. $EQ^{[electricity]}_{i}$	*lager-equivalent energy consumption factor for electricity*	*estimation*	*No dimension*	*estimated*	*Once before implementation of the project*	*100%*	*electronic*	*Lager-equivalent energy consumption factor for electricity of the product category i. Other product category can be used.*
P0-h-i. $EQ^{[heat]}_{i}$	*lager-equivalent energy consumption factor for heat*	*estimation*	*No dimension*	*estimated*	*Once before implementation of the project*	*100%*	*electronic*	*Lager-equivalent energy consumption factor for heat of the product category i. Other product category can be used.*
P1-e. $Q_{y}^{[Electricity-eq]}$	*Beer production of the facility*	*meter*	*kL-beer*	*calculated*	*daily*	*100%*	*electronic*	*Aggregated by using "lager-equivalence (heat)" over the product category i of $Q_{i,y}$. Aggregation to be done monthly basis.*
P1-e-0. $Q^{[Electricity-eq]}_{0}$	*Beer production of the facility before implementation*	*meter*	*kL-beer*	*calculated*	*daily*	*100%*	*electronic*	*Beer production average of the latest 18 months before implementation of the project*
P1-h. $Q_{y}^{[heat-eq]}$	*Beer production of the facility*	*meter*	*kL-beer*	*calculated*	*daily*	*100%*	*electronic*	*Aggregated by using "lager-equivalence (heat)" over the product category i*

								of $Q_{i,y}$. Aggregation to be done monthly basis.
P1-i. $Q_{i,y}$	*Beer production of the facility (product category i)*	*meter*	*kL-beer*	*measured*	*daily*	*100%*	*electronic*	*Aggregated monthly production volume is checked against the sales and stock record of beer products*
P1. Q_y	*Beer production of the facility*	*meter*	*kL-beer*	*measured*	*daily*	*100%*	*electronic*	*Aggregated monthly production volume is checked against the sales and stock record of beer products*
P2-k. $Q\_Energy_{k,y}$	*Energy source k consumed*	*meter (e.g., weightometer, wattmeter, etc.)*	*Physical unit or energy unit*	*measured*	*daily*	*100%*	*electronic*	*All energy sources consumed at the facility. The energy source k includes the fuel(s) such as coal, heavy fuel oil, diesel oil, … and external electricity purchased from grid. Checked against the purchase record (receipt).*
P3-k. $SEC^{PJ}_{k,y}$	*Specific energy consumption rate of energy k*	*calculated from P1. & P2.*	*[Physical unit or energy unit] / kL-beer*	*calculated*	*monthly*	*100%*	*electronic*	$IP_{k,y} = P\_Energy_{k,y}/P_y$
P3-int_el. $SEC^{PJ}_{electricity}{}^{INT}_{y}$	*Specific energy consumption rate of internal electricity*	*calculated*	*kWh/ kL-beer*	*calculated*	*monthly*	*100%*	*electronic*	$SEC^{PJ}_{electricity}{}^{INT}_{y} = Q\_Energy_{InternalElectricity,y} / Q_y^{[Electricity\text{-}eq]}$
P4-k. $CEF_{k,y}$ *(excl. Grid Electricity)*	*Carbon emission factor of energy k*	*Information provided by the fuel supplier*	tCO_2 */ [Physical unit or energy unit]*	*Provided or calculated (by using energy content and carbon content of the fuel)*	*yearly*	*100%*	*electronic*	*If sufficient data is not provided by the fuel supplier, regular (monthly) sampling should be done to measure such carbon emission factor. For coal, take many*

								samples to check the dispersion of data. Afterwards, regular (monthly) sampling by lot is applied. Checked against the IPCC default values.
P4- GridElectricity. $CEF_{GridElectricity,y}$	*Carbon emission factor of grid electricity*	*Information provided by the grid operator or Statistics of the electric power company*	*tCO_2/kWh*	*Provided or calculated (CO_2 / kWh from the marginal plant(s))*	*yearly*	*100%*	*electronic*	*Confirmation: no build margin component by interviewing the power development officer (once). Identification of marginal plant(s) by interviewing the grid operator (once) or apply some conservative method specified in the baseline methodology. The marginal plant(s) or plant type(s) may differ by month.*
P5. $Loss_{GridElectriocity,y}$	*Transmission & distribution loss*	*Obtained from power supplier's statistics or information*	*dimensionless*	*Cited*	*yearly*	*100%*	*electronic*	*Latest statistics or information is applied.*

B.2.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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The amount of project emissions PE_y in a given year y is given by

$$PE_y = Q_y * \sum_k SEC^{PJ}_{k,y} * CEF_{k,y} / (1 - Loss_{k,y}) = \sum_k Q\_Energy_{k,y} * CEF_{k,y} / (1 - Loss_{k,y})$$

where Q_y is the annual production of beer of the facility [kL-beer/yr], $SEC^{PJ}_{k,y}$ (= $Q\_Energy_{k,y}/Q_{k,y}$) is the specific energy consumption rate (energy intensity) of the project scenario [kcal/kL-beer], and $CEF_{k,y}$ is the CO_2 emission factor of the energy k (such as external electricity, diesel oil, heavy oil, *etc*.) [tCO_2/kcal or tCO_2/t-fuel, tCO_2/kL-fuel] consumed in the facility (measured annually).

$Loss_{k,y}$ is the transmission and distribution loss of the grid for k = external electricity. Otherwise, $Loss_{k,y}$= 0.

B.2.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of greenhouse gases (GHG) within the project boundary and how such data will be collected and archived:

ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
B0-i. $Q^{PLAN}_{i,y}$	*Beer production in the baseline scenario as planned for beer specified by i*	*Beer production plan*	*[kL-beer/yr]*	*Referred*	-	*100%*	*electronic*	*In case beer production capacity increase scenario without energy efficiency improvement chosen as the baseline scenario (i.e., identified as the economically most attractive course of action without the CER revenue) is,* $Q_{i,y}$ *is replaced as* $Q^{PLAN}_{i,y}$ *as planned, if and only if appropriate and sufficient documented evidences are provided by the project participants. The DOE (validator) assesses the appropriateness of such evidences considering the related data/information*

								which may support such a plan. If the DOE finds that such information is insufficient, $Q_{i,y}$ is set to be common for the baseline scenario and the project scenario as the conservative estimation.
B1-k. $SEC^{BL}_{k,y}$	*Specific energy consumption rate of energy k*	*Calculated by* $SEC^{BL}_{electricity,y}$ *and* $SEC^{BL}_{heat,y}$	*[Physical unit or energy unit] / kL-beer*	*calculated*	*monthly*	*100%*	*electronic*	*See B.4. for calculation of* $SEC^{BL}_{electricity}$ $^{GRID}_{y}$
B2. $SEC^{BL}_{electricity,y}$	*Specific energy consumption rate of electricity*	*Calculated by regression analysis*	*kWh /kL-beer*	*calculated*	*monthly*	*100%*	*electronic*	*Refer to the baseline methodology. Significance of the data is checked by the beer authority.*
B2-0. $SEC^{BL}_{electricity}$ $^{INT}_{0}$	*Specific energy consumption rate of electricity for past 18 months*	*Calculated from B2*	*kWh /kL-beer*	*calculated*	*Once before implementation*	*100%*	*electronic*	*Average of internal electricity related specific energy consumption rate for past 18 years before implementation of the project*
B3. $SEC^{BL}_{heat,y}$	*Specific energy consumption rate of heat*	*Calculated by regression analysis*	*Mcal (or physical unit of fuel) /kL-beer*	*calculated*	*monthly*	*100%*	*electronic*	*Refer to the baseline methodology. Significance of the data is checked by the beer authority.*
B4. Q^{before}_{y}	*Beer production prior to implementation of the project*	*Meter or sales/stock record*	*kL-beer*	*measured*	*Monthly before implementation of the project*	*100%*	*electronic*	*Used to obtain* $SEC^{BL}_{electricity,y}$ *and* $SEC^{BL}_{heat,y}$ *by using regression analysis. Checked against the sales/stock/purchase records.*
B5. $Electricity^{before}_{y}$	*Electricity consumption prior to implementation of the project*	*Wattmeter*	*kWh*	*Measured (and calculated)*	*Monthly before implementation of the project*	*100%*	*electronic*	*Used to obtain* $SEC^{BL}_{electricity,y}$ *by using regression analysis. Aggregated value of the purchased electricity and in-house generation.*

								Checked against the sales/stock/purchase records.
B6. $Heat^{before}_{y}$	*Heat consumption prior to implementation of the project*	*Weightometer or others to measure fuel consumption*	*Mcal or physical unit of the fuel*	*Measured (and calculated)*	*Monthly before implementation of the project*	*100%*	*electronic*	*Used to obtain $IB_{heat,y,}$ by using regression analysis. Aggregated value of the fuels by using their energy content.*
B7. $BioMethane^{before}$	*Annual bio-based methane from lagoon prior to implementation of the project*	*Direct measurement by sampling*	*tCH_4*	*Measured*	*Monthly sampling before implementation of the project*	*-*	*electronic*	*Needed if the current practice of wastewater treatment is by anaerobic lagoon. This is applied before the beer production capacity is expanded. Measurement by sampling should be done monthly to estimate annual emissions. (Typical temperature condition should be selected every month). Checked against the rough estimation by using IPCC Tier 1 method.*
B8. $OrganicWaste^{before}$	*Annual organic waste disposed to the lagoon prior to implementation of the project*	*Direct measurement by sampling*	*ton*	*Measured*	*Monthly sampling*	*-*	*electronic*	*Needed if the current practice of wastewater treatment is by anaerobic lagoon. This is applied before the beer production capacity is expanded. Measurement by sampling should be done monthly to estimate annual disposal.*
B9. $OrganicWaste_{y}$	*Monthly organic waste treated at the wastewater treatment system*	*Direct measurement*	*ton*	*Measured*	*Monthly*	*100%*	*electronic*	*Needed if the current practice of wastewater treatment is by anaerobic lagoon. This is applied before the beer production capacity is expanded.*

B.2.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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$$BE_y = Q_y^{[\text{Electricity-eq}]} * \sum_k SEC^{BL}_{k,y} * CEF_{k,y} / (1 - Loss_{k,y}) + Q_y^{[\text{Heat-eq}]} * \sum_k SEC^{BL}_{k,y} * CEF_{k,y}$$

where

$Q_{i,y}$:	annual production of beer/beverage at the facility [kL-beer/yr] of a category *i* (*e.g.*, lager, stout, juice, *etc.*),
$Q_y^{[\text{Electricity-eq}]}$:	annual production of "beer" at the facility [kL-beer/yr] calculated by using "lager-eq." for electricity, defined as $\sum_i Q_{i,y} * EQ(\text{electricity})_i$,
$Q_y^{[\text{Heat-eq}]}$:	annual production of "beer" at the facility [kL-beer/yr] calculated by using "lager-eq." for heat, defined as $\sum_i Q_{i,y} * EQ(\text{heat})_i$,
$EQ^{[\text{electricity}]}_i$:	lager-equivalent energy consumption factor for electricity,
$EQ^{[\text{heat}]}_i$:	lager-equivalent energy consumption factor for heat,
$SEC^{BL}_{k,y}$:	specific energy consumption rate (energy intensity) of the baseline scenario [kcal/kL-beer] of the energy type *k* (such as external electricity, diesel oil, heavy oil, *etc*),
$CEF_{k,y}$:	CO_2 emission factor of energy *k*
$Loss_{k,y}$:	transmission and distribution loss of the grid for *k* = external electricity. Otherwise, $Loss_{k,y}$= 0.

$Q_y^{[\ ]} = \sum_i Q_{i,y} * EQ^{[\ ]}_i$ is the annual production of beer at the facility [kL-beer/yr] calculated by using "lager-eq. (for electricity)" and "lager-eq. (for heat)", *i.e.*, adjusted one of the beer production.[2] It is noted that $EQ^{[\ ]}_i$ is different for electricity use and heat use. $Q_{i,y}$ is assumed to be common for the baseline scenario and the project scenario (if the beer production capacity increase scenario is not chosen as the baseline scenario) and monitored *ex post*. $EQ^{[\ ]}_i$ is estimated using technical consideration prior to implementation of the project and assumed to be constant.

In case beer production capacity increase scenario without energy efficiency improvement chosen as the baseline scenario (*i.e.*, identified as the economically most attractive course of action without the CER revenue) is, $Q_{i,y}$ is replaced as $Q^{PLAN}_{i,y}$ as planned, if and only if appropriate and sufficient documented evidences are provided by the project participants. The DOE (validator) assesses the appropriateness of such evidences

[2] Electricity and heat are two major energy usage modes. Both of them are functions of beer production. However, the beer factory may produce several types of beer and beverages, in general. In this methodology, beer production is adjusted by each type of beer by using "lager-equivalence" concept (no need to specify "lager", while some typical type of beer is set for the basis). As "lager-equivalence" concept may be different for electricity and heat consumption, the lager-equivalent beer production has two different ones such as $Q_y^{[\text{Electricity-eq}]}$ and $Q_y^{[\text{heat-eq}]}$.

considering the related data/information which may support such a plan. If the DOE finds that such information is insufficient, $Q_{i,y}$ is set to be common for the baseline scenario and the project scenario as the conservative estimation.

Summation over *k* is for the fuel for heat part; and electricity and fuel for power generation for electricity part) [tCO_2/kcal or tCO_2/t-fuel, tCO_2/l-fuel] consumed in the facility (measured annually). It is noted that $Q_{i,y}$ and $SEC^{BL}_{k,y}$ are monitored and estimated *monthly* basis.

If the project does not install new power generation system, it is reasonable to assume that $Q_y * SEC^{BL}_{electricity}{}^{INT}_{y}$ *is common (*$=Q_y * SEC^{PJ}_{electricity}{}^{INT}_{y}$*)* for baseline and project scenarios, therefore

$$SEC^{BL}_{electricity}{}^{GRID}_{y} = SEC^{BL}_{electricity,y} - SEC^{PJ}_{electricity}{}^{INT}_{y}$$

where $SEC^{PJ}_{electricity}{}^{INT}_{y}$ *(*$=Q\_Energy_{InternalElectricity,y}/ Q_y^{[Electricity\text{-}eq]}$*)* is that of the project scenario.[3]

If the project installs power generation system, beer production level adjusted in-house power generation is assumed based on the latest 18 months performance to estimate $SEC^{BL}_{electricity}{}^{GRID}_{y}$:

$$SEC^{BL}_{electricity}{}^{INT}_{y} = (Q_y^{[Electricity\text{-}eq]} / Q^{[Electricity\text{-}eq]}_{0}) * SEC^{BL}_{electricity}{}^{INT}_{0}$$

where the parameter with suffix "0" is the average of the latest 18 months before implementation of the project. Therefore,

$$SEC^{BL}_{electricity}{}^{GRID}_{y} = SEC^{BL}_{electricity,y} - (Q_y^{[Electricity\text{-}eq]} / Q^{[Electricity\text{-}eq]}_{0}) * SEC^{BL}_{electricity}{}^{INT}_{0}$$

As for the heat part, $SEC^{BL}_{heat,y}$ is decomposed into each fuel with the same ratio of the project scenario.

If an anaerobic lagoon system (which emits methane) is used for wastewater treatment before implementation of the project, the methodology concludes that such treatment system is to be used until the beer production capacity is added. Therefore, until that time (monitored *ex post*), methane is considered to be emitted in the baseline scenario.

$$BE_y^{BioGas} = BioMethane^{before} * (OrganicWaste_y / OrganicWaste^{before}) * GWP\_CH_4$$

where $BioMethane^{before}$ is the annual emission of the biogas-based methane measured before implementation of the project, $OrganicWaste^{before}$ is the annual organic waste measured in the same period as $BioMethane^{before}$. $OrganicWaste_y$ is the annual organic waste in a given year *y* after implementation of the project. GWP_CH_4 (= 21) is the global warming potential with 100-year time horizon specified in the IPCC Second Assessment Report for the 1st Commitment Period.

It should be noted that these emissions are applied before expanding the beer production capacity of the existing plant case, only.

B.3. Option 2: Direct monitoring of emission reductions from the project activity:

[3] It should be noted that $SEC^{PJ}_{electricity}{}^{INT}_{y}$ is obtained by the fuel use for in-house power generation.

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Not applicable.

B.3.1. Data to be collected or used in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

B.3.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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B.4. Treatment of leakage in the monitoring plan:

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No significant leakage is found.

B.4.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity:								
ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

B.4.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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B.5. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

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The amount of emission reductions ER_y in a given year y is given by

$$ER_y = BE_y - PE_y$$

See the notations above.

B.6. Assumptions used in elaborating the new methodology:

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No significant assumptions are added to those specified in the baseline methodology (see Section E.1. of the new baseline methodology).

B.7. Please indicate whether quality control (QC) and quality assurance (QA) procedures are being undertaken for the items monitored:

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
P1, P2, B4, B5	*Low*	*Checked against the sales/stock/purchase records.*
P4-k	*Low*	*If sufficient data are not provided by the fuel supplier, regular (monthly) sampling should be done to measure such carbon emission factor.* *For coal, take many samples to check the dispersion of data. Afterwards, regular (monthly) sampling by lot is applied. Checked against the IPCC default values.*
B2, B3	*Low*	*Significance of the data is checked by the beer authority.*
B7	*Low*	*Checked against the rough estimation by using IPCC Tier 1 method.*
All	*Low*	*Consistency with the past records are checked in order to minimize errors.*

In general, a management system is established to identify/clarify the responsibilities for monitoring, recording and reporting the parameters. Its appropriateness is to be checked by the operational entity.

B.8. Has the methodology been applied successfully elsewhere and, if so, in which circumstances?

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No application is found.

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