

Indicative simplified baseline and monitoring methodologies  
for selected small-scale CDM project activity categories

**TYPE III - OTHER PROJECT ACTIVITIES**

Project participants shall apply the general guidelines to SSC CDM methodologies and information on additionality (attachment A to Appendix B) provided at <http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html> *mutatis mutandis*.

***III.AY. Introduction of LNG buses to existing and new bus routes***

**Technology/measure**

1. This methodology is applicable to project activities that introduce new LNG buses to existing and new routes.
2. The following applicability conditions apply:
  - (a) The existing and new routes are fixed;
  - (b) LNG buses are only for passenger transportation;
  - (c) For each route, only one type of bus as well as one type of fuel (e.g. gasoline or diesel) is used in the baseline or project scenario;
  - (d) The methodology is applicable only if it can be demonstrated that the most plausible baseline scenario for the project activity is the baseline defined in paragraph 6 and 7 of the methodology;
  - (e) For any new routes implemented by the project activity, it shall be demonstrated with credible official documented evidence that these new routes had been already planned prior to the start date of the project activity and that these routes were to be serviced by fossil fuel buses. Examples of such evidence include transportation plans of the local planning office, transportation authority or bus company;
  - (f) The project and baseline buses for each route are comparable, which means that project and baseline buses for each route have comparable passenger capacity and power rating with a variation of not more than +/- 10%, and if baseline buses have air conditioning, the project buses shall also have air conditioning;
  - (g) The frequency of operations of the buses should be the same in the project and the baseline scenarios;
  - (h) Procedures such as a contractual agreement or unique identification of the buses shall be implemented to avoid the potential double counting of emission reductions by involved parties, including, for example, the bus company or owner, the manufacturer of the buses, and/or the supplier of the LNG. These procedures shall be described in the Project Design Document.
3. Measures are limited to those that result in emission reductions of less than or equal to 60kt CO<sub>2</sub> equivalent annually.

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**Boundary**

4. The project boundary includes the following:
- (a) The buses which use LNG as fuels;
  - (b) The geographical area covering the physical routes along which LNG buses operate;
  - (c) Auxiliary facilities such as fuelling stations, workshops and service stations that are visited by the LNG buses.

**Baseline**

5. The baseline is determined by assessing alternatives to existing and new routes in the project region. The baseline alternatives shall provide comparable services (e.g. transportation capacity) as the proposed project activity.
6. For existing routes, the baseline is the continuation of the current practice, i.e. the operation of the bus routes with the regular maintenance and replacement procedures of the existing buses.
7. For new routes, the baseline is the operation of new routes with comparable new buses that use liquid fossil fuels such as gasoline or diesel.
8. The emission reductions due to the displacement of existing buses can be claimed until the end of the remaining lifetime of the baseline buses. The remaining lifetime of the baseline buses is determined as the average lifetime of the buses minus the vehicle age.
9. GHG emission reductions are achieved through introducing LNG buses to existing and new routes of the city replacing liquid fuels (diesel or gasoline) that would have otherwise been used in the buses in the absence of the proposed project activity. The indicator used to demonstrate and calculate emission reductions is emissions per kilometer. It is a value based on specific fuel consumption data of the respective route.

**Baseline emission factor for route *i***

$$EF_{KM,BL,i,y} = SFC_{BL,i,y} \times NCV_{BL,i} \times EF_{CO_2,BL,i} \times IR^t \quad (1)$$

Where:

$EF_{KM,BL,i,y}$  Emission factor per kilometer of baseline buses of route *i* in year *y* (tCO<sub>2</sub>/km)

$SFC_{BL,i,y}$  Specific fuel consumption of baseline buses of route *i* in year *y* (t/km)

$NCV_{BL,i}$  Net calorific value of baseline fuel used in route *i* (GJ/t)

$EF_{CO_2,BL,i}$  Carbon emission factor for baseline fuel used in route *i* (tCO<sub>2</sub>/GJ)

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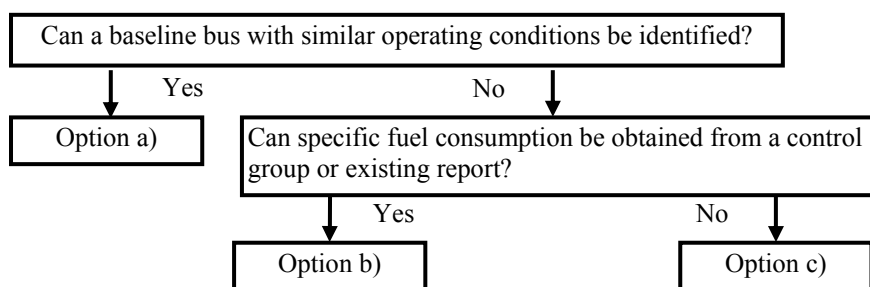
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$IR^t$  Technology improvement factor for the baseline buses per year  $t$  (see paragraph 13). The improvement rate is applied to each calendar year

$t$  Year counter for the annual improvement (dependent on age of data)

10. The emission factor for baseline buses of each route shall be reassessed for each new crediting period. This may require studies or reliable up-to-date literature data (e.g. specific fuel consumption studies) in order to reflect the latest situation in the corresponding region.

11. The specific fuel consumption of baseline bus for route  $i$  ( $SFC_{BL,i,y}$ ) is determined as follows (in order of preference):



- (a) When a specific baseline bus can be identified, i.e. a bus used along the same route and therefore with similar operating conditions, the following applies:  $SFC_{BL,i,y}$  is determined from the lowest of following two methods:
- Average operational data of the bus under baseline operating conditions, using at least one year of operational data, if that data is available;
  - Fuel efficiency obtained from manufacturer's specification, if it can be demonstrated that the value is conservative given the operating conditions of the baseline buses;
- (b) If no specific baseline bus can be identified or appropriate operational data is not available, then specific fuel consumption should be obtained through a statistically significant control group or existing statistics. Such group or the source of data must have similar or conservative characteristics with respect to vehicle age (equal or newer), traffic conditions (equal or better), capacity (equal or larger) and air conditioning. The choice of such control group will be, in descending order:
- Routes of the same company operating simultaneously with the project activity;
  - Routes of company with similar operations operating simultaneously with the project activity;
  - Host country statistics;
  - IPCC or other international data;

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- (c) Other cases. Where neither option (a) nor (b) is feasible then baseline specific fuel consumption is determined by using the fuel efficiency of top 20% of the routes before project activity, as determined according to travel distance of each bus for the previous three years. If no data exists for the time period, a shorter period can be chosen, with a minimum period of one year.

12. For option (b), specific fuel consumption is monitored throughout the project crediting period thus gradual efficiency improvements of the route or gradual deterioration of driving conditions would automatically be incorporated into the project efficiency levels. Hence, value of the technology improvement factor is fixed as 1. For option (a) and (c), the technology improvement factor is fixed as 0.99.

13. The specific fuel consumption of the buses used in new routes shall be determined as the most conservative option calculated as per the procedures in paragraph 12, based on data for new buses.

14. The baseline emissions for all passengers transported by the project are calculated as follows:

$$BE_y = \sum_i (EF_{KM,BL,i,y} \times \sum_k TD_{BL,k,i,y}) \quad (2)$$

Where:

$BE_y$  Baseline emissions in the year  $y$  (tCO<sub>2</sub>e)

$EF_{KM,BL,i,y}$  Emission factor per kilometer of baseline buses of route  $i$  in year  $y$  (tCO<sub>2</sub>/km)

$TD_{BL,k,i,y}$  Total annual distance travelled by baseline bus  $k$  of route  $i$  in the year  $y$  (km)

15. Additionality is demonstrated using one of the options below:

**Option 1:**

Demonstrate that the project activity would otherwise not be implemented due to the existence of one or more barrier(s) listed in attachment A of Appendix B of 4/CMP.1 Annex II <<http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html>>.

**Option 2:**

Demonstrate *ex ante* that the market share of project buses is less than or equal to 5% of the buses (not only public transport bus) in the region.

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**Leakage**

16. No leakage is considered in this methodology.

**Project activity emissions**

17. Project emissions are determined by monitoring the consumption of LNG by the buses introduced by the project activity, according to the following formula:

$$PE_y = FC_{PJ,LNG,y} * NCV_{LNG,y} * EF_{CO2,LNG,y} \quad (3)$$

Where:

$PE_y$  Total project emissions in year  $y$  (tCO<sub>2</sub>)

$FC_{PJ,LNG,y}$  Consumption of LNG by the project activity in year  $y$  (tons)

$NCV_{LNG,y}$  Net calorific value of LNG used by the project activity in year  $y$  (GJ/t)

$EF_{CO2,LNG,y}$  CO<sub>2</sub> emission factor of LNG used by the project activity in year  $y$  (tCO<sub>2</sub>/GJ)

**Emission reductions**

18. Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad (3)$$

Where:

$ER_y$  Emission reductions in year  $y$  (t CO<sub>2</sub>/y)

$LE_y$  Leakage emissions in year  $y$  (t CO<sub>2</sub>/y)

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**Monitoring****Data and parameters not monitored**

<b>Data / Parameter:</b>	$NCV_{BL,i}$	
Data unit:	GJ/t	
Description:	Net calorific value of fuel used in route $i$	
Source of data:	The following data sources may be used if the relevant conditions apply:	
	<b>Data source</b>	<b>Conditions for using the data source</b>
	(a) Values provided by the fuel supplier in invoices taken from a sample of gas stations in the city	This is the preferred source
	(b) Measurements by the project participants taken from a sample of gas stations in the city	If (a) is not available
	(c) Regional or national default values	If (a) is not available These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances)
	(d) IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	
Measurement procedures (if any):	For (a) and (b): Measurements should be undertaken in line with national or international fuel standards	
Any comment:		

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<b>Data / Parameter:</b>	$EF_{CO_2, BL, i}$	
Data unit:	tCO <sub>2</sub> /GJ	
Description:	CO <sub>2</sub> emission factor for fuel used in route <i>i</i>	
Source of data:	The following data sources may be used if the relevant conditions apply:	
	<b>Data source</b>	<b>Conditions for using the data source</b>
	a) Values provided by the fuel supplier in invoices taken from a sample of gas stations in the city	This is the preferred source
	b) Measurements by the project participants taken from a sample of gas stations in the city	If a) is not available
	c) Regional or national default values	If a) is not available These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances)
	d) IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	
Measurement procedures (if any):	For a) and b): Measurements should be undertaken in line with national or international fuel standards. For a): If fuel suppliers provide the NCV value and the CO <sub>2</sub> emission factor on the invoices and these two values are based on measurements for this specific fuel, this CO <sub>2</sub> factor should be used. If another source for the CO <sub>2</sub> emission factor is used or no CO <sub>2</sub> emission factor is provided, options b), c) or d) should be used	
Any comment:		

<b>Data / Parameter:</b>	Remaining lifetime of vehicles (Paragraph 8)
Data unit:	years
Description:	Average lifetime of baseline vehicles
Source of data:	Vehicle registration statistics
Measurement procedures (if any):	The lifetime is calculated as twice the average age of the vehicles in the baseline or is based on a sample/survey of vehicles, determining the average age by taking the lower 95% confidence interval of the sample (lifetime = average age *2)
Any comment:	

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**Data and parameters monitored**

<b>Data / Parameter:</b>	$SFC_{BL,i,y}$
Data unit:	t/km
Description:	Specific fuel consumption of baseline buses of route $i$ in year $y$
Source of data:	Operation records
Measurement procedures (if any):	As detailed in paragraph 12
Monitoring frequency:	As detailed in paragraph 12
QA/QC procedures:	As detailed in paragraph 12
Any comment:	

<b>Data / Parameter:</b>	$TD_{BL,k,i,y}$
Data unit:	Kilometre
Description:	Total annual distance travelled by baseline bus $k$ of route $i$ in the year $y$ (km)
Source of data:	Bus records
Measurement procedures (if any):	Odometer reading
Monitoring frequency:	Continuously
QA/QC procedures:	The meter reading shall be crosschecked by driver logs and route maps
Any comment:	

<b>Data / Parameter:</b>	$FC_{PJ,LNG,y}$
Data unit:	ton
Description:	Quantity of LNG consumed by the buses covered by the project activity
Source of data:	LNG fill records
Measurement procedures (if any):	fuel meters at the fuelling station for the LNG buses
Monitoring frequency:	Continuously
QA/QC procedures:	Cross check measurement results with invoices for purchased LNG
Any comment:	



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<b>Data / Parameter:</b>	$NCV_{LNG,y}$	
<b>Data unit:</b>	GJ/t	
<b>Description:</b>	Net calorific value of LNG used by project activity in year $y$	
<b>Source of data:</b>	The following data sources may be used if the relevant conditions apply:	
	<b>Data source</b>	<b>Conditions for using the data source</b>
	a) Values provided by the fuel supplier in invoices taken from a sample of LNG stations in the city	This is the preferred source
	b) Measurements by the project participants taken from a sample of LNG stations in the city	If a) is not available
	c) Regional or national default values	If a) is not available These sources can only be used for liquid fuels and should be based on well-documented, reliable sources (such as national energy balances).
	d) IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	
<b>Measurement procedures (if any):</b>	For a) and b): Measurements should be undertaken in line with national or international fuel standards.	
<b>Monitoring frequency:</b>	For a) and b): The NCV should be obtained for each fuel delivery, from which weighted average annual values should be calculated For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account	
<b>QA/QC procedures:</b>	Verify if the values under a), b) and c) are within the uncertainty range of the IPCC default values as provided in Table 1.2, Vol. 2 of the 2006 IPCC Guidelines. If the values fall below this range collect additional information from the testing laboratory to justify the outcome or conduct additional measurements. The laboratories in a), b) or c) should have ISO17025 accreditation or justify that they can comply with similar quality standards.	
<b>Any comment:</b>		

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<b>Data / Parameter:</b>	EF <sub>CO<sub>2</sub>LNG,y</sub>	
<b>Data unit:</b>	tCO <sub>2</sub> /TJ	
<b>Description:</b>	CO <sub>2</sub> emission factor for LNG used by project activity in year y	
<b>Source of data:</b>	The following data sources may be used if the relevant conditions apply:	
	<b>Data source</b>	<b>Conditions for using the data source</b>
	a) Values provided by the fuel supplier in invoices taken from a sample of gas stations in the city	This is the preferred source
	b) Measurements by the project participants taken from a sample of gas stations in the city	If a) is not available
	c) Regional or national default values	If a) is not available These sources can only be used for liquid fuels and should be based on well documented, reliable sources (such as national energy balances)
	d) IPCC default values at the lower limit of the uncertainty at a 95% confidence interval as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories	
<b>Measurement procedures (if any):</b>	For a) and b): Measurements should be undertaken in line with national or international fuel standards.	
<b>Monitoring frequency:</b>	For a) and b): The CO <sub>2</sub> emission factor should be obtained for each fuel delivery, from which weighted average annual values should be calculated. For c): Review appropriateness of the values annually For d): Any future revision of the IPCC Guidelines should be taken into account	
<b>QA/QC procedures:</b>		
<b>Any comment:</b>	For a): If the fuel supplier does provide the NCV value and the CO <sub>2</sub> emission factor on the invoice and these two values are based on measurements for this specific fuel, this CO <sub>2</sub> factor should be used. If another source for the CO <sub>2</sub> emission factor is used or no CO <sub>2</sub> emission factor is provided, Options b), c) or d) should be used	

**Project activity under a programme of activities:**

19. The following conditions apply for use of this methodology in a project activity under a programme of activities:

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Leakage resulting from fuel extraction, processing, liquefaction, transportation, re-gasification and distribution of fossil fuels outside of the project boundary shall be considered. The guidance provided in the leakage section of ACM0009 “Consolidated baseline and monitoring methodology for fuel switching from coal or petroleum fuel to natural gas” shall be followed in this regard.

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**History of the document**

<b>Version</b>	<b>Date</b>	<b>Nature of revision</b>
01	EB 66, Annex # 02 March 2012	To be considered at EB 66.
<b>Decision Class:</b> Regulatory <b>Document Type:</b> Standard <b>Business Function:</b> Methodology		