CLEAN DEVELOPMENT MECHANISM

AMS-III.BC

Small-scale Methodology

Emission reductions through improved efficiency of vehicle fleets

Version 02.0

Sectoral scope(s): 07

United Nations
Framework Convention on
Climate Change

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1. Introduction

1. The following table describes the key elements of the methodology:

Table 1. Methodology key elements

Typical project(s)	Improvement of the operational efficiency of vehicle fleets (e.g. fleets of trucks, buses, cars, taxis or motorized tricycles)
Type of GHG emissions mitigation action	Energy efficiency: Fossil fuels savings through various equipment and/or activity improvement

2. Scope, applicability, and entry into force

2.1. Scope

2. This methodology is for project activities that improve the efficiency of vehicle fleets (e.g. fleets of trucks, buses, cars, taxis or motorized tricycles), resulting in reduced fuel usage and greenhouse gas emissions.

3. The project activity shall implement one or more of the following measures:

   (a) Idling stop device;[1]

   (b) Eco-drive systems;[2]

   (c) Tire-rolling resistance improvements;[3]

   (d) Air-conditioning system improvements;[4]

   (e) Use of low viscosity oils;[5]

[1] Refers to the action of turning off the vehicle engine and thus preventing idling (as specifically defined above) and the associated fuel consumption that would otherwise have occurred while idling, in absence of the project activity. Anti-idling devices can also include techniques to avoid use of the base engine during extended idle by substituting alternative sources of HVAC (heating, ventilation or air conditioning) and electricity during rest stops.

[2] Eco-drive systems include equipment that monitors vehicle and driver performance and provides real-time feedback to drivers on efficient driving behaviour.

[3] Rolling resistance can be reduced by avoiding under-inflation of existing tyres e.g. through automatic tire inflation (ATI), usage of special low rolling resistance tyres, or substituting one wide tyre for a pair of dual tyres on trucks.

[4] Enhanced air conditioning systems can decrease base engine load requirements from mobile air conditioning systems by replacing fixed displacement compressors (FDCs) with externally controlled variable displacement compressors (VDCs), using improved control systems, condensers and evaporators.

[5] Low-viscosity engine lubricants are made from synthetic or mineral oil blends for the purpose of reducing internal engine friction. Low viscosity oils based on SAE-Viscosity classes are 0W30 and 5W30.

(f) Aerodynamic drag reduction measures;[6]

(g) Transmission improvements;[7]

(h) Retrofits that improve engine efficiency.[8]

4. More than one energy efficiency measure covered by the methodology may be implemented in the project vehicle fleet(s) and the measures implemented may vary across vehicles in the fleet(s).

5. Vehicle fleets shall be centrally owned and managed by a single entity and driven by contractors or employees of the central entity.

6. The project proponents shall provide ex ante estimation of the percentage of baseline emissions avoided per each energy efficiency measure. The ex ante estimations shall be based on published literature, official reports or statistics published by independent third party or studies carried out by project proponents and validated by designated operational entities. The ex ante estimations will also serve as a cap on the emission reductions, for example the reduction in the project emission factor compared to the baseline emission factor (per tonne-km or per km) shall not exceed the ex ante estimation.

2.2. Applicability

7. The methodology is not applicable to project activities that include:

(a) Measures that improve the system efficiency of the fleet, for example a change of operational procedures to improve the occupancy rate of vehicles and modal shift in transportation;

(b) Technologies employed to improve combustion efficiency without improvements in engine efficiency;

(c) A switch from fossil fuels to biofuels in transportation applications. The usage of a fixed biofuel blend is, however, admissible if project vehicles use the same blend of biofuel as used by baseline vehicles. In the case of using biofuel blends, the biofuel share is accounted for as zero emitting;

[6] Aerodynamic drag of trucks can be significantly reduced by installing add-on devices to improve the vehicle profile (truck tractor aerodynamic drag reduction options include cab top deflector, sloping hood, and cab side flares; truck side and underside aerodynamic drag reduction options include closing and covering the gap between a tractor and trailer (or van), aerodynamic bumper, underside air baffles, and wheel well covers), pneumatic blowing systems (this type of system blows air from slots at the rear of the trailers of heavy-duty vehicles in order to smooth air flow over the trailer surfaces and reduce aerodynamic drag, and boat tail plates rectangular plates mounted to the end of a trailer in an attempt to reduce the wake of trucks), or by improving vehicle load profile.

[7] Improving transmission systems by using high-efficiency transmission technologies i.e. continuously variable transmission (CVT) and/or low-viscosity transmission lubricants.

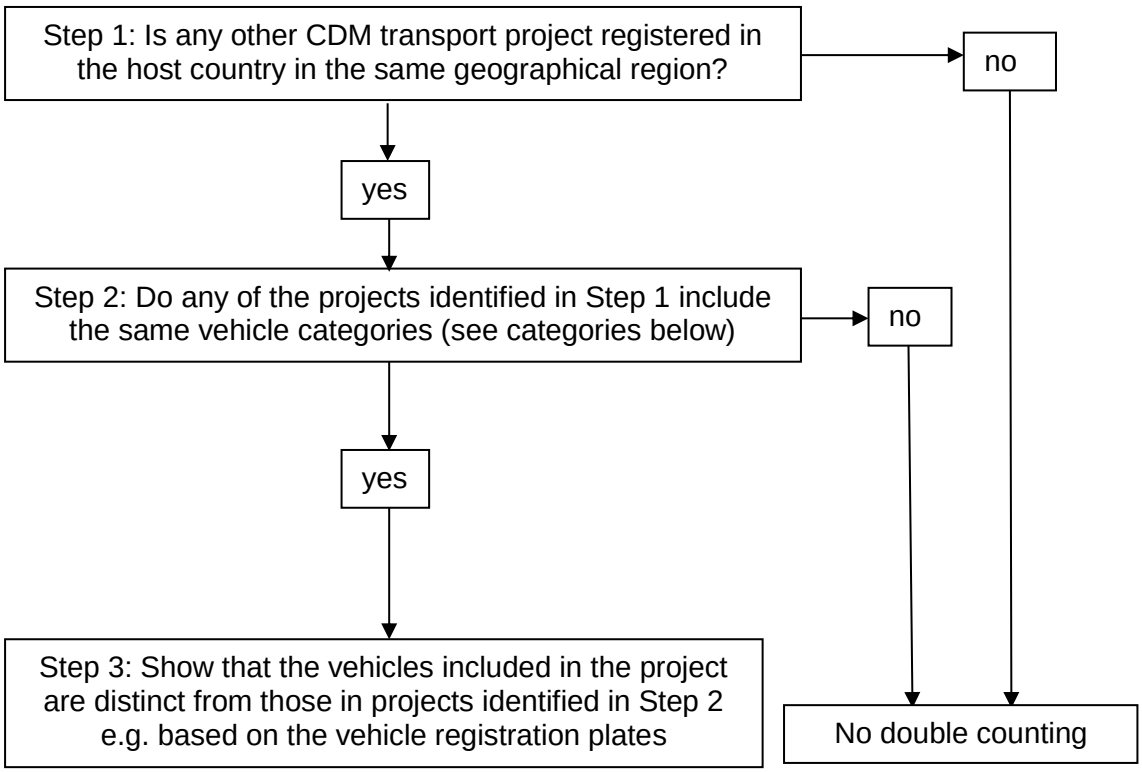
[8] Retrofits involves direct installation of technologies onto the vehicle/engine that improve the efficiency of engine operation by, for example, tapping into spare unused kinetic energy, solar energy or thermo-electric generation and/or generating hydrogen on board to be used as a catalyst, e.g. electro-catalytic efficiency technologies.

(d) A fuel-switch, for example from liquid to gaseous fuels.

8. Project fleets may use various fuel types. The composition of the fleet with regard to fuel types used may also change over time. The introduction of hybrid vehicles is allowed. Hybrid fuel vehicles are classified according to their fossil fuel engine type and compared with the same baseline fossil fuel type (e.g. compressed natural gas, diesel, gasoline hybrids are compared with diesel, gasoline or compressed natural gas engines).

9. Only vehicles in which at least one of the ex ante identified project activity measures has been implemented shall be included in the project fleet.

10. The project design document (PDD) shall include documentation of procedures to eliminate any potential double counting of emission reductions due to, for example, the project vehicles participating in other CDM projects or Programmes of Activities (PoAs). The following steps shall be carried out in the PDD and in each Monitoring Report to avoid double counting of emission reductions.



11. Each fleet included in the project activity shall include only one vehicle category. In each vehicle category, vehicles are classified according to the fuel types used. Baseline and project emissions are calculated for each fuel type of each vehicle category. A project activity may, however, encompass various fleets. Vehicle categories in the context of this methodology are:

(a) Trucks with a gross vehicle weight[9] (GVW) >3.5 t;

(b) Trucks with a GVW <3.5t;

(c) Buses with a GVW >3.5 t;

(d) Taxis: in the case of significantly different taxi types such as conventional cars, minibuses, jeepneys, etc., these shall also be considered as separate vehicle categories;

(e) Passenger cars (e.g. company cars, rental cars);

(f) Motorized tricycles (e.g. used as taxis or for deliveries).

12. Measures are limited to those that result in emission reductions of less than or equal to 60 ktCO_2 equivalent annually.

2.3. Entry into force

13. The date of entry into force is the date of the publication of the EB 75 meeting report on 4 October 2013.

3. Normative references

14. Project participants shall apply the "General guidelines for SSC CDM methodologies" and the "Guidelines on the demonstration of additionality of small-scale project activities" (previously known as attachment A to appendix B) provided at: <http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html> mutatis mutandis.

15. This methodology refers to the latest version of the following methodological tools and guidelines[10] mutatis mutandis:

(a) "General guidelines for SSC CDM methodologies";

(b) The standard on "Sampling and surveys for CDM project activities and programmes of activities";

4. Definitions

16. The definitions contained in the Glossary of CDM terms shall apply.

17. For the purpose of this methodology, the following definitions apply:

(a) **Heavy duty vehicles** - vehicles with gross vehicle weight more than or equal to 3.5 t are classified as heavy duty vehicles;

[9] The gross vehicle weight (GVW) is the maximum allowable total weight of a vehicle when loaded. This weight includes the vehicle as well as fuel, passengers and cargo. This is a fixed weight that is set and specified by the vehicle manufacturer.

[10] Please refer to: <https://cdm.unfccc.int/Reference/index.html>.

(b) **Light duty vehicles** - vehicles with gross vehicle weight less than 3.5 t are classified as light duty vehicles.

5. Baseline methodology

5.1. Project boundary

18. The project boundary is the physical, geographical location of the vehicles that are part of the project activity. The spatial extent of the project boundary encompasses the geographical area of the trips of these project vehicles.

5.2. Additionality

19. Additionality may be demonstrated based on typical barriers faced by energy efficiency projects, including but not limited to:

(a) Commercial/legal barriers: the "owner/tenant" contractual issue typical of energy efficiency projects may be a legitimate barrier. This is typical for example in the case of the fleets of car rental companies where the car renter buys the fuel and the owner makes the vehicle investment. Many taxi fleets especially in developing countries are also managed in this manner, with taxi drivers paying a fixed daily rent per vehicle. The same is true in the case of leased vehicles typical in the trucking business;

(b) Aggregation barriers: in order to make implementation of efficiency projects feasible, they may require an aggregation mechanism. Aggregation mechanisms, in the case of promoting efficiency in transport fleets, have been successful for example in Switzerland, Canada and the United States. Aggregation parties are generally business associations, efficiency-driven institutions or providers of technology solutions for efficiency improvements. The cost of establishing and maintaining such an aggregation mechanism can, however, be a major barrier that can be offset with carbon revenues;

(c) Common practice barrier: energy efficiency technologies are often not common practice. Fleet owners are often sceptical of such practices and resistant to adopt them. A project activity is considered to be additional if the market penetration rate of each of the planned project measures is less than 5 per cent for the types of vehicles included in the fleets.[11] Sources of data for the market penetration rates may include independent studies, information from business associations, analysis of publicly available information demonstrating the "penetration rate" of the measures proposed by the project within the host country, sample surveys of comparable fleets that ask fleet managers to identify vehicles in which the identified efficiency measures have been implemented in the absence of the CDM, or random sample surveys of the same vehicle categories, carried out, for example, at bus/truck/taxi depots in major cities.

[11] Penetration rates are assessed for the specific categories of vehicles in which the measures are implemented, and not for the fleet as a whole, because a project may implement specific measures only on some vehicles and not the entire fleet. To assess the penetration rate for the fleet, a weighting based on the number of each type of vehicle is made. Each planned measure must fulfil the threshold value of 5 per cent individually if this barrier is used.

5.3. Baseline emissions

20. The baseline scenario is the operation of a group of vehicles of the same fleet, in which the project measures are not implemented, for similar transportation services as the project vehicles. Baseline emissions are calculated based on a baseline emissions factor (BEF) derived from the monitored specific fuel consumption of a control group of vehicles and the monitored project activity level. The BEF is monitored annually. The metric used for the baseline emissions is:

    (a) Emissions per tonne-km (tkm) for heavy duty vehicles;

    (b) Emissions per km for all other vehicle categories.

21. To avoid crediting emission reductions to the project for external factors, the baseline emission factor shall be based on comparable vehicles driving in a comparable situation. This can be based either on a Randomized Control Trial (RCT) as described in paragraph 22 or with a control group that complies with the following conditions to ensure that the control group is comparable to or more conservative than the project group:

    (a) For buses, passenger cars, taxis and jeepneys, the following criteria shall be comparable for the control and the project group: average vehicle age, area of usage of the vehicle (e.g. urban or inter-urban routes), average passenger capacity and average share of vehicles with air conditioning. The control group vehicles must have on an average, the same age or less than the project group vehicles. The control group vehicles must be used on average in the same area of usage as the project vehicles. The control group vehicles must have on an average the same or a lower passenger capacity than the project vehicles. The share of vehicles with air conditioning in the control group must be the same or lower than that of the project group;

    (b) For trucks the criteria are: average GVW, average annual distance driven and main area of usage of the vehicles (urban vs. inter-urban trips). The average GVW of vehicles in the control group must be the same or greater than that of the vehicles in the project group. The average annual distance driven of the vehicles in the control group must be the same or greater than that of the vehicles in the project group. The share of inter-urban trips of vehicles in the control group must be on average equal to or higher than the share of the project vehicles.

22. Control group vehicles shall be selected from the vehicle fleets of the project proponent or from third party fleets (preferred option). For the RCT, the population of interest is randomly assigned to either a project (where energy efficiency measures are implemented) or a control group. Each vehicle in the population of all eligible vehicles is randomly assigned to either the control or project group based on a random probability, as opposed to being assigned to one group or the other based on some characteristic of the vehicle (e.g. vehicle age or willingness of a driver to sign up for the project activity).[12]

[12] Random assignment creates a control group that is statistically identical to the project group, in both observable and unobservable characteristics, such that any difference in outcomes between the two groups can be attributed to the treatment (project activity) with a high degree of validity (i.e. that the savings estimates are unbiased and precise).

23. Baseline emissions for trucks and buses are calculated based on the baseline emission factor per tkm per fuel type determined based on the monitoring of the control group vehicles. The baseline emission factor is multiplied by the actual tkm transported by the project activity per fuel type.

$$BE_y = \sum_{i,x} BEF_{tkm,i,x,y} \times AL_{tkm,i,x,y} \times 10^{-6} \quad \text{Equation (1)}$$

Where:

BE_y = Baseline emissions in the year *y* (t CO_2)

$BEF_{tkm,i,x,y}$ = Baseline emission factor per tkm of vehicle category *i* using fuel type *x* in the year y (gCO_2/tkm)

$AL_{tkm,i,x,y}$ = Activity level of project in tkm of vehicle category *i* using fuel type *x* in the year *y* (tkm)

$$BEF_{tkm,i,x,y} = \frac{SFC_{BL,i,x,y} \times NCV_{x,y} \times EF_{CO2,x,y}}{AW_{BL,i,x,y}} \quad \text{Equation (2)}$$

Where:

$SFC_{BL,i,x,y}$ = Specific baseline fuel consumption of control group vehicle category *i* using fuel type *x* in year *y* (g/km)

$NCV_{x,y}$ = Net calorific value of fuel type *x* in year *y* (MJ/g)

$EF_{CO2,x,y}$ = CO_2 emission factor for fuel type *x* in year *y* (gCO_2/MJ)
For electric or hybrid vehicles the emission factor is determined in accordance with the latest version of "AMS-III.C: Emission reductions by electric and hybrid vehicles"

$AW_{BL,i,x,y}$ = Average GVW per vehicle unit of control group vehicle category *i* using fuel type *x* in the year *y* (tonnes). The gross vehicle weight as per vehicle registration or the maximum technical weight specified by the manufacturer of the vehicle should be used for the calculations

24. Vehicle categories are indicated in paragraph 11. The project can include vehicle sub-categories.

25. Baseline emissions for all other vehicle categories are calculated based on the baseline emission factor per km per fuel type determined for the control group vehicles. The baseline emission factor is multiplied by the actual distance travelled by the project activity fleet.

$$BE_y = \sum_{i,x} BEF_{km,i,x,y} \times AL_{km,i,x,y} \times 10^{-6} \quad \text{Equation (3)}$$

Where:

$BEF_{km,i,x,y}$ = Baseline emission factor per kilometre of vehicle category *i* using fuel type *x* in the year *y* (gCO_2/km)

$AL_{km,i,x,y}$ = Activity level of project in km, of vehicle category *i* using fuel type *x* in the year *y* (km)

$$BEF_{km,i,x,y} = \left(SFC_{BL,i,x,y} \times NCV_{x,y} \times EF_{CO2,x,y}\right) \quad \text{Equation (4)}$$

5.4. Leakage

26. No leakage calculation is required.

5.5. Project activity emissions

27. Project emission calculations for trucks and buses:

$$PE_y = \sum_{i,x} PEF_{tkm,i,x,y} \times AL_{tkm,i,x,y} \times 10^{-6} \quad \text{Equation (5)}$$

Where:

PE_y = Project emissions in the year *y* (t CO_2)

$PEF_{tkm,i,x,y}$ = Project emission factor per tkm of vehicle category *i* using fuel type *x* in year *y* (gCO_2/tkm)

$$PEF_{tkm,i,x,y} = \frac{SFC_{PJ,i,x,y} \times NCV_{x,y} \times EF_{CO2,x,y}}{AW_{PJ,i,x,y}} \quad \text{Equation (6)}$$

Where:

$SFC_{PJ,i,x,y}$ = Specific project fuel consumption of project group vehicle category *i* using fuel type *x* in the year *y* (g/km)

$AW_{PJ,i,x,y}$ = Average GVW per vehicle unit of project group vehicle category *i* using fuel type *x* in the year *y* (tonnes). The gross vehicle weight as per vehicle registration or the maximum technical specified by the manufacturer of the vehicle should be used for the calculations

28. Project emissions for all other vehicle categories:

$$PE_y = \sum_{i,x} PEF_{km,i,x,y} \times AL_{km,i,x,y} \times 10^{-6} \quad \text{Equation (7)}$$

Where:

$PEF_{km,i,x,y}$ = Project emission factor per kilometre of vehicle category *i* using fuel type *x* in the year *y* (gCO_2/km)

$$PEF_{km,i,x,y} = SFC_{PJ,i,x,y} \times NCV_{x,y} \times EF_{CO2,x,y}$$ Equation (8)

6. Monitoring methodology

6.1. Data and parameters monitored

29. The following data and parameters shall be monitored:

Data / Parameter table 1.

Data / Parameter:	**$NCV_{x,y}$**
Data unit:	MJ/g
Description:	Net calorific value of fuel type *x* in the year *y*
Source of data:	National values or the latest version IPCC
Measurement procedures (if any):	-
Monitoring frequency:	Annual
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 2.

Data / Parameter:	**$EF_{CO2,x,y}$**
Data unit:	gCO_2/MJ
Description:	CO_2 emission factor of fuel type *x* in the year *y*
Source of data:	National values or the latest version IPCC
Measurement procedures (if any):	-
Monitoring frequency:	Annual
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 3.

Data / Parameter:	**$SFC_{BL,i,x,y}$**
Data unit:	g/km
Description:	Specific baseline fuel consumption of control group vehicle category *i* using fuel type *x* prior to project start
Source of data:	Control group data
Measurement procedures (if any):	Measurements are undertaken throughout the crediting period for the vehicles in the control group
Monitoring frequency:	Annual
QA/QC procedures:	The latest version of the standard for “Sampling and surveys for CDM project activities and programme of activities” shall be followed
Any comment:	-

Data / Parameter table 4.

Data / Parameter:	**$SFC_{PJ,i,x}$**
Data unit:	g/km
Description:	Specific project fuel consumption of project group vehicle category *i* using fuel type *x* in the year *y*
Source of data:	Control group data
Measurement procedures (if any):	Measurements are undertaken throughout the crediting period for the vehicles under the project group
Monitoring frequency:	Annual
QA/QC procedures:	If the SFC is not based on all project vehicles, but based on a sample, the latest version of the standard for "Sampling and surveys for CDM project activities and programme of activities" shall be followed
Any comment:	-

Data / Parameter table 5.

Data / Parameter:	**$AW_{BL,i,x,y}$**
Data unit:	tonnes
Description:	Average gross weight per vehicle unit of vehicle category *i* using fuel type *x* in year *y*
Source of data:	Control group data
Measurement procedures (if any):	The average GVW per vehicle unit is the average of the individual weight of vehicles of the control group fleet using fuel type *x*
Monitoring frequency:	Annual
QA/QC procedures:	To ensure data consistency SFC and AW must be based on the same group of vehicles
Any comment:	-

Data / Parameter table 6.

Data / Parameter:	**$AW_{PJ,i,x,y}$**
Data unit:	tonnes
Description:	Average gross weight per vehicle unit of vehicle category *i* using fuel type *x* in year *y*
Source of data:	Control group data
Measurement procedures (if any):	The average GVW per vehicle unit is the average of the individual weight of vehicles of the project group fleet using fuel type *x*
Monitoring frequency:	Annual
QA/QC procedures:	To ensure data consistency SFC and AW must be based on the same group of vehicles
Any comment:	-

Data / Parameter table 7.

Data / Parameter:	**$AL_{tkm,i,x,y}$**
Data unit:	tkm
Description:	Activity level of project in tkm of vehicle category *i* using fuel type *x* in year *y*
Source of data:	Control group data
Measurement procedures (if any):	Measurements are undertaken throughout the crediting period for the vehicles under the project group. Used for trucks and buses. Option 1 (preferred option) fleet data: The GVW and the distance driven is recorded for each vehicle on a monthly or annual basis or the total vehicle distance per fuel type *x* per month/year is multiplied by the average monthly GVW per vehicle of the fleet. Option 2 sample: Sample of vehicles randomly chosen in accordance with the latest version of the the standard for "Sampling and surveys for CDM project activities and programme of activities". The total fleet tkm is the average tkm per vehicle of the sample multiplied by the number of operational fleet vehicles per month. The number of operational units per month must be recorded
Monitoring frequency:	Monthly or Annual
QA/QC procedures:	-
Any comment:	Measurement devices for distance driven: this can be based on GPS or comparable or odometer reading

Data / Parameter table 8.

Data / Parameter:	**$AL_{km,i,x,y}$**
Data unit:	km
Description:	Activity level of project in km of vehicle category *i* using fuel type *x* in the year *y*
Source of data:	Control group data
Measurement procedures (if any):	Measurements are undertaken throughout the crediting period for the vehicles in the project group. Monitored for all vehicle categories. Option 1 (preferred option) fleet data: The distance driven is recorded for each vehicle on a monthly or annual basis. Option 2 sample: Sample of vehicles randomly chosen in accordance with the latest version of the "Standard for sampling and surveys for CDM project activities and programme of activities". The total fleet distance is the average per vehicle of the sample multiplied with the number of vehicles of the fleet in that month using fuel type *x*. The number of operational units per month must be recorded

Monitoring frequency:	Monthly or Annual
QA/QC procedures:	-
Any comment:	Measurement devices for distance driven: this can be based on GPS or comparable or odometer reading

30. If any device installed in a project vehicle (e.g. for Ecodrive or engine retrofits, including fuel flow sensors (meters) is not operating correctly and or have not been disabled, no emissions reductions can be attributed to that vehicle for the period that the system has not been operating correctly.

6.2. Project activity under a programme of activities

31. The methodology is applicable for a programme of activities if the total emission reduction claims from all measures does not exceed 20 per cent, or, if the total emission reductions are greater than 20 per cent, the amount of reductions has been appropriately justified as being attributable to the project measures as documented in independent, relevant studies by the independent third parties (i.e. studies of the emissions reductions from the project devices).[13]

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[13] Considering the uncertainties related to for example data collection on parameters via control groups.

Document information

Version	*Date*	*Description*
02.0	4 October 2013	EB 75, Annex 24 Revision to: • Include engine efficiency retrofits to vehicles that improves combustion efficiency; • Update the provision related to PoA.
01.0	20 July 2012	EB 68, Annex 16 Initial adoption.

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