CLEAN DEVELOPMENT MECHANISM

AMS-III.C

Small-scale Methodology

Emission reductions by electric and hybrid vehicles

Version 15.0

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)	Operation of electric and hybrid vehicles for providing transportation services.
Type of GHG emissions mitigation action	Fuel switch. Displacement of more-GHG-intensive vehicles.

2. Scope, applicability, and entry into force

2.1. Scope

2. This methodology applies to project activities introducing new electric and/or hybrid vehicles that displace the use of fossil fuel vehicles in passenger and freight transportation.

2.2. Applicability

3. The methodology is not applicable for project activities that involve a switch from fossil fuels to biofuels in transportation; those project activities shall consider using another Type III methodology (e.g. "AMS-III.T.: Plant oil production and use for transport applications" and "AMS-III.AK.: Biodiesel production and use for transport applications").

4. In cases where the project vehicles use a replaceable, chargeable battery there must be documented measures in place to ensure that vehicle owners have access to replacement batteries of comparable quality.

5. The project design document (PDD) shall explain the proposed approach for introducing/distributing the electric/hybrid vehicles, which shall allow for tracking of the project vehicles. It shall also explain how the proposed project activity will:

   (a) Demonstrate that the baseline vehicles being displaced are those consuming fossil fuels.[1] This can be done, for example, through documentation of the market share per fuel type per vehicle category in the project region (e.g. based on representative sample surveys or official data or peer reviewed literature);

   (b) Ensure compliance with prevailing regulations pertaining to battery use and disposal.

6. The PDD shall include minimum performance specifications for the batteries to be used such as: depth of discharge, battery cycles, distance travelled per charge, lifetime.

7. The project proponent shall demonstrate that double counting of emission reductions will not occur e.g. via a contractual agreement with the end-user(s), maintenance of

[1] If any biofuel blends are used, blends up to 20 per cent by volume are eligible and emission reductions shall be discounted by the percentage of biofuel in the blend (e.g. 20 per cent in the case of B20).

comprehensive inventory of project vehicles or unique identification of the vehicles owned by end-user(s). The steps undertaken to avoid double counting shall be documented in the PDD.

8. In cases where renewable energy source is used for charging the electric vehicles through a dedicated transmission/distribution line, the methodology should be combined with "AMS-I.F.: Renewable electricity generation for captive use and mini-grid" to claim emission reductions for the amount of electricity supplied from renewable electricity source to the charging station.[2]

9. In cases where this methodology is combined with "AMS-I.F.: Renewable electricity generation for captive use and mini-grid", the project proponent shall separately demonstrate the additionality of each of the component (i.e supply of renewable energy to charging station (Type I) and use of electric vehicles (Type III)). Furthermore while combining the two components applicable requirements on start date and prior clean development mechanism (CDM) consideration shall be met in accordance with the CDM project standard and CDM project cycle procedures.

10. Types of hybrid/electric vehicles to be introduced include but are not limited to cars, buses, trucks, jeepneys, commuter vans, taxis, motorcycles and tricycles.

11. Project participants shall demonstrate that the project and baseline vehicles are comparable, using the following means:

    (a) Project and baseline vehicles belong to the same vehicle category, e.g. motorcycle, bus, taxi, truck, tricycle;

    (b) Project and baseline vehicle categories have comparable passenger/load capacity and power rating with a variation of no more than 20 per cent (comparing the baseline vehicle with the respective project vehicle of same category).

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 83 meeting report on the 16 April 2015.

3. Normative references

14. 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.

15. This methodology also refers to the latest approved versions of the following tool and methodologies:

[2] In case where renewable energy source is connected to charging station via national/regional grid, project proponent should consider this as a separate project and may explore using "AMS-I.D.: Grid connected renewable electricity generation".

(a) "AMS-I.D.: Grid connected renewable electricity generation";

(b) "AMS-I.F.: Renewable electricity generation for captive use and mini-grid";

(c) "AMS-III.T.: Plant oil production and use for transport applications";

(d) "AMS-III.AK.: Biodiesel production and use for transport applications";

(e) "Guidelines for sampling and surveys for CDM project activities and programme of activities";

(f) "Methodological tool: Demonstration of additionality of small-scale project activities";

(g) "Tool to calculate baseline, project and/or leakage emissions from electricity consumption".

4. Definitions

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

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

(a) **Hybrid vehicle** – is a vehicle which combines an internal combustion engine and one or more electric motors.

5. Baseline methodology

5.1. Project Boundary

18. The project boundary is comprised of:

(a) The vehicles of the project;

(b) The geographic boundaries where the project activity vehicles are operated;

(c) The providers of the charging service to the project activity vehicles, including the charging equipment and stations of the project activities vehicle, electric supply sources (e.g. a grid and/or renewable energy generation source connected by a dedicated line to the charging stations) and other ancillary facilities.

5.2. Additionality

19. For the specific case of this methodology, additionality is demonstrated using one of the options below:

5.2.1. Option 1:

20. Demonstrate that the project activity would otherwise not be implemented due to the existence of one or more barrier(s) listed in the "Methodological tool: Demonstration of additionality of small-scale project activities". The barrier(s) can be demonstrated for buyers/users and/or charging service providers of the electric vehicles even if the manufacturer or retailer of the electric vehicles is implementing the project.

5.2.2. Option 2:

21. Demonstrate ex ante that the market share of project electric/hybrid vehicles is equal to or smaller than 5 per cent of the vehicles of the same category (e.g. if project vehicles are electric scooters, market share of electric two wheelers is equal to or smaller than 5 per cent of all motorized two wheelers, irrespective of the manufacturer) in the region.

5.3. Baseline

22. The baseline scenario in case of operation of electric vehicles is the operation of the comparable vehicles (the comparability of baseline and project vehicles to be demonstrated as per indicators in paragraph 11 above) that would have been used to provide the same transportation service.

23. When combining this methodology with "AMS-I.F.: Renewable electricity generation for captive use and mini-grid", the baseline for the supply of electricity from renewable electricity source shall be determined as per AMS-I.F.

5.4. Baseline emissions

24. The baseline emissions on account of supply of electricity to the charging stations from a dedicated renewable energy source shall be estimated as per "AMS-I.F.: Renewable electricity generation for captive use and mini-grid".

25. Baseline emissions should be calculated using one of the two approaches described below:

26. Approach 1: Using distance travelled by project vehicles

27. The baseline emissions are calculated based on the unit of service provided by the project vehicles (travelled distance) times the emission factor for the baseline vehicle to provide the same unit of service as per the equation below:

$$BE_y = \sum_i EF_{BL,km,i} \times DD_{i,y} \times N_{i,y} \times 10^{-6} \qquad \text{Equation (1)}$$

Where:

BE_y = Total baseline emissions in year *y* (t CO_2)

$EF_{BL,km,i}$ = Emission factor for baseline vehicle category *i* (g CO_2/km)

$DD_{i,y}$ = Annual average distance travelled by project vehicle category *i* in the year *y* (km)

$N_{i,y}$ = Number of operational project vehicles in category *i* in year *y*

28. Approach 2: Using the electricity used to charge the vehicles

29. The baseline emissions are calculated as per the equation below by transforming the electricity charged to the vehicles at the charging stations/points into travelled distance and the emission factor for fossil fuels used by the baseline vehicles to travel the same distance.

$$BE_y = \sum_i EF_{BL,km,i} \times \frac{EC_{PJ,i,y}}{SEC_{PJ,km,i,y}} \times 10^{-6}$$ Equation (2)

Where:

BE_y = Total baseline emissions in year *y* (t CO_2)

$EC_{PJ,i,y}$ = The electricity consumed for charging project vehicles category i at the charging stations/points in year y (kWh)

$EF_{BL,km,i}$ = Emission factor for baseline vehicle category *i* (g CO_2/km)

$SEC_{PJ,km,i,y}$ = Specific electricity consumption per km per project vehicle category i in year y (kWh/km)

30. The Emission factor for baseline vehicle category ($EF_{BL,km,i}$) shall be determined as follows*:*

$$EF_{BL,km,i} = SFC_i \times NCV_{BL,i} \times EF_{BL,i} \times IR^t$$ Equation (3)

Where:

SFC_i = Specific fuel consumption of baseline vehicle category *i* (g/km)

$NCV_{BL,i}$ = Net calorific value of fossil fuel consumed by baseline vehicle category *I* (J/g)

$EF_{BL,i}$ = Emission factor of fossil fuel consumed by baseline vehicle category *i* (g CO_2/J)

IR^t = Technology improvement factor for baseline vehicle in year *t.* The improvement rate is applied to each calendar year. The default value of the technology improvement factor for all baseline vehicle categories is 0.99

T = Year counter for the annual improvement (dependent on age of data per vehicle category)

31. The specific fuel consumption of baseline vehicle category *i* (SFC_i) shall be determined using one of the following options:

5.4.1. Option (1): Sample measurement

32. Measure the actual fuel consumption rate of a representative sample of vehicles, for each vehicle category identified for highway driving. Vehicle categories shall be determined conservatively and be based on the fuel type used, the vehicle category, engine model year, power rating, passengers/load capacity auxiliary equipment (e.g. with and without air conditioners) and other relevant factors to distinguish vehicles with different fuel consumption rates. Sample vehicles shall be randomly chosen in accordance with the latest version of the "Guidelines for sampling and surveys for CDM project activities and programme of activities" using a 90 per cent confidence interval

and +/- 10 per cent precision to determine the sample size. The lower bound of 95 per cent confidence interval shall be used as the Specific Fuel Consumption.

5.4.2. Option (2): Top 20 per cent of the comparable vehicles used for public/private transportation

33. The specific fuel consumption for comparable vehicles is estimated by using the specific fuel consumption for highway driving obtained from manufacturer's specification of the top 20 per cent of vehicles operated/used for public/private transportation in the project region.

5.4.3. Option (3): Using operational data of the vehicles under baseline operational conditions

34. When a specific baseline vehicle can be identified, that is a vehicle used in the same area and with similar operating conditions and this vehicle will not be replaced over the life of the project, the following options appliy:

    (a) Specific fuel consumption (SFC_i) is determined from the average operational data of the vehicle(s) under baseline operating conditions, using at least one year of operational data, if that data is available, Otherwise

    (b) SFC_i should be obtained from manufacturer's specifications, if it can be demonstrated that the value is conservative given the operating conditions of the baseline vehicles (e.g. values for specific fuel consumption under standard testing conditions provided by the manufacturers). This may be the case when the project activity introduces new vehicles, and the baseline vehicle is also new and provides a similar service.

35. In project activities where baseline vehicles include non-standard vehicles such as jeepneys or tricycles, which are assembled locally, and for which manufacturers´ data is not available, the specific fuel consumption may be determined using one of the following two options:

    (a) Measure the actual fuel consumption and corresponding distance travelled of a sample of baseline vehicles operating in comparable traffic situations with a similar age or newer, a similar or smaller engine size, a similar or lower passenger/goods load capacity, and a similar weight or lighter and other relevant factors to distinguish vehicles with different fuel consumption rates. Sample vehicles shall be randomly chosen in accordance with the latest version of the "Guidelines for sampling and surveys for CDM project activities and programme of activities" using a 90 per cent confidence interval and a 10 per cent precision to determine the sample size. The lower bound of 95 per cent confidence interval shall be used as the specific fuel consumption;

    (b) Use a specific fuel consumption value from peer-reviewed literature source or report authored by a nationally/internationally recognized independent third party or a research institute under the following two conditions to ensure conservative value:

        (i) The specific fuel consumption value was derived from measurements taken under highway driving conditions or similar non-urban traffic conditions;

(ii) The specific fuel consumption value for baseline vehicles was derived with characteristics leading to similar or lower emissions as compared to the baseline vehicles, for example use specific fuel consumption values for vehicles of a similar age or newer, a similar or smaller engine size, a similar or lower passenger/goods load capacity, and a similar weight or lighter and other relevant factors to distinguish vehicles with different fuel consumption rate.

5.4.4. Option (4): Using data from a control group of vehicles

36. If no specific baseline vehicle 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 that are regularly updated. Such a control group or the source of data must shall have similar or conservative characteristics with respect to vehicle age (equal or newer), traffic conditions (equal or better), and air conditioning. The choice of such control group will be, in order of preference:

(a) Fleet of the same company operating simultaneously with the project activity;

(b) Fleet of company with similar operations operating simultaneously with the project activity.

(c) Host country statistics;

(d) IPCC or other international data.

37. Under this option specific fuel consumption is monitored throughout the project crediting period thus gradual efficiency improvements of the fleet or gradual deterioration of driving conditions would automatically be incorporated into the project efficiency levels.

5.4.5. Option (5): Existing statistics

38. If none of the above options apply due to lack of data, other public available existing statistics could be used as industry default values, such as host country statistics (released by transportation department or other authorities), IPCC or other international data.

5.5. Project Emissions

39. Project emissions include the electricity and fossil fuel consumption associated with the operation of project vehicles and shall be calculated as follows:

40. Approach 1: Using distance travelled by project vehicles

$$PE_y = \sum_i EF_{PJ,km,i,y} \times DD_{i,y} \times N_{i,y} \qquad \text{Equation (4)}$$

Where:

PE_y = Total project emissions in year *y* (t CO_2)

$EF_{PJ,km,i,y}$ = Emission factor per kilometre travelled by the project vehicle type *i* (t CO_2/km)

$N_{i,y}$ = Number of operational project vehicles in category *i* in year *y*

$DD_{i,y}$ = Annual average distance travelled by the project vehicle category *i* in the year *y* (km)

41. Approach 2: Using the electricity used to charge the vehicles

$$PE_y = \sum_i EF_{PJ,km,i,y} \times \frac{EC_{PJ,i,y}}{SEC_{PJ,km,i,y}} \quad \text{Equation (5)}$$

Where:

$EC_{PJ,i,y}$y = Electricity consumed by the project vehicles of type i in year y (kWh)

$SEC_{PJ,km,i,y}$ = Specific electricity consumption by project vehicle category *i* per km in year *y* in urban conditions (kWh/km)

i Vehicle types of project activities

42. The emission factor of the project vehicles shall be established as follows:

$$EF_{PJ,km,i,y} = \sum_i SEC_{PJ,km,i,y} \times EF_{elect,y}/\left(1 - TDL_y\right) \times 10^{-3} + \sum_i SFC_{PJ,km,i,y} \times NCV_{PJ,i} \times EF_{PJ,i} \times 10^{-6} \quad \text{Equation (6)}$$

Where:

$SEC_{PJ,km,i,y}$ = Specific electricity consumption by project vehicle category *i* per km in year *y* in urban conditions (kWh/km)

$EF_{elect,y}$ = CO_2 emission factor of electricity consumed by project vehicle category *i* in year *y* (kg CO_2/kWh)

$SFC_{PJ,km,i,y}$ = Specific fossil fuel[3] consumption by project vehicle category *i* per km in year *y* in urban conditions (g/km*)*

$EF_{PJ,i}$ = CO_2 emission factor of fossil fuel consumed by project vehicle category *i* in year *y* (g CO_2/J)

$NCV_{PJ,i}$ = Net calorific value of the fossil fuel consumed by project vehicle category *i* in year *y* (J/g)

TDL_y = Average technical transmission and distribution losses for providing electricity in the year *y*

[3] For electric vehicle the values is 0.00.

5.6. Leakage

43. No leakage calculation is required.

5.7. Emission reductions

44. Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad \text{Equation (7)}$$

Where:

ER_y = Emission reductions in year *y* (t CO_2e)

BE_y = Baseline emissions in year *y* (t CO_2e)

PE_y = Project emissions in year *y* (t CO_2e)

LE_y = Leakage emissions in year *y* (t CO_2e)

6. Monitoring methodology

45. Relevant parameters shall be monitored and recorded during the crediting period as indicated in the section below. The applicable requirements specified in the "General guidelines for SSC CDM methodologies" are also an integral part of the monitoring guidelines specified below and therefore shall be followed by the project participants.

Data / Parameter table 1.

Data / Parameter:	$DD_{i,y}$
Data unit:	km
Description:	Annual average distance driven by project vehicle *i* in year *y* (km/yr)
Source of data:	Measurement
Measurement procedures (if any):	Measure the annual average distance driven by the project vehicles through: Option (A): monitoring of all vehicles or Option (B): representative sample survey of vehicles for each vehicle category. Sample vehicles shall be chosen in accordance with the latest version of the "Guidelines for sampling and surveys for CDM project activities and programme of activities" using a 90 per cent confidence interval and +/- 10 per cent precision to determine the sample size. The lower bound of 95 per cent confidence interval shall be used as the annual distance travelled
Any comment:	-

Data / Parameter table 2.

Data / Parameter:	TDL_y
Data unit:	percentage
Description:	Average technical transmission and distribution losses for providing electricity in the year *y*
Source of data:	
Measurement procedures (if any):	As per the procedures of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"
Any comment:	-

Data / Parameter table 3.

Data / Parameter:	$SEC_{PJ,km,i,y}$
Data unit:	kWh/km
Description:	Specific electricity consumption per km per project vehicle category *i* in year *y*
Source of data:	Measurement
Measurement procedures (if any):	Measure the specific electricity consumption through: Option (A): monitor electricity consumption of all project vehicles or Option (B): measure the amount of electricity consumed per km travelled for a representative sample of each vehicle category. Sample vehicles shall be chosen in accordance with the latest version of the "Guidelines for sampling and surveys for CDM project activities and programme of activities" using a 90 per cent confidence interval and +/- 10 per cent precision to determine the sample size. The upper bound of 95 per cent confidence interval shall be used for the specific fuel/electricity consumed. Cross-checked against vehicle specifications (kWh/km) for urban conditions provided by the manufacturers and use the highest of the two values
Any comment:	-

Data / Parameter table 4.

Data / Parameter:	$SFC_{PJ,km,i,y}$
Data unit:	g/km
Description:	Specific fossil fuel consumption per km per project vehicle category *i* in year *y*
Source of data:	Measurement

Measurement procedures (if any):	Measure the specific fossil fuel consumption through: Option (A): monitor consumption of all project vehicles or Option (B): measure the amount of fossil fuels consumed per km travelled for a representative sample of each vehicle category. Sample vehicles shall be chosen in accordance with the latest version of the "Guidelines for sampling and surveys for CDM project activities and programme of activities" using a 90 per cent confidence interval and +/- 10 per cent precision to determine the sample size. The upper bound of 95 per cent confidence interval shall be used for the specific fuel/electricity consumed. Cross-checked against vehicle specifications (g/km) for urban conditions provided by the manufacturers and use the highest of the two values
Any comment:	-

Data / Parameter table 5.

Data / Parameter:	$NCV_{BL,i}$, $NCV_{PJ,i}$
Data unit:	J/g
Description:	Net calorific value of fuel *i*
Source of data:	
Measurement procedures (if any):	Country specific data or IPCC default value
Any comment:	-

Data / Parameter table 6.

Data / Parameter:	$EF_{BL,i}$, $EF_{PJ,i}$
Data unit:	g CO_2/J
Description:	CO_2 emission factor of fuel used by vehicles category *i*
Source of data:	
Measurement procedures (if any):	Country specific data or IPCC default value
Any comment:	-

Data / Parameter table 7.

Data / Parameter:	**EF_{elect}**
Data unit:	kg CO_2/kWh
Description:	CO_2 emission factor of electricity used by project vehicle
Source of data:	Measurement
Measurement procedures (if any):	As per procedures of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"
Any comment:	-

Data / Parameter table 8.

Data / Parameter:	$N_{i,y}$
Data unit:	-
Description:	Number of project vehicle in operation in year *y*
Source of data:	
Measurement procedures (if any):	Establish the number of the project vehicles in operation through: Option (A): based on annual sales records or official data on registered project vehicles cross-checked against the results from a representative sample survey vehicles to determine the percentage of vehicles in use or Option (B): based on annual sales records or official data for registered project vehicles, multiplied by the default factor 0.9^t, where *t* is year counter for the number of years since the vehicle was introduced (for example: if *n* vehicles are sold in year 1, in year 2 the number of vehicles still in operation are assumed to be equal to $n*0.9$, and in year 3, $n*0.9^2$, etc.)
Any comment:	-

Data / Parameter table 9.

Data / parameter:	$EC_{PJ,i,y}$
Data unit:	kWh
Description:	Electricity consumed by the project vehicles of type *i* in year *y*
Source of data:	Electric charging records at the electricity charging station
Measurement procedures (if any):	
Any comment:	The electric charging records will be crosschecked by driver logs or invoices from electricity filling station

7. Project activity under a Programme of Activities

46. The methodology is applicable for a programme of activities.

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Document information*

Version	*Date*	*Description*
15.0	16 April 2015	EB 83, Annex 9 To include the additional option based on electricity used for charging the vehicles for calculation of baseline emissions and project emissions.
14.0	28 November 2014	EB 81, Annex 19 Expand applicability to include vehicle charging service providers and elaborate procedures for avoidance of double counting of emission reductions. Include additional options to determine specific fuel consumption of baseline vehicles.
13.0	3 June 2011	EB 61, Annex 19 Include specific guidance for demonstrating additionality; Elaborate procedures for calculating baseline, project emissions and monitoring parameters.
12.0	30 July 2010	EB 55, Annex 31 Clarify that the methodology is applicable for electric and hybrid vehicles; Under the PoA section leakage provisions pertaining to project activities involving fossil fuel switch measures has been excluded.
11.0	27 July 2007	EB 33, Annex 31 Expand for application under a programme of activities (PoA).
10.0	15 December 2006	EB 28, Para 54 Remove the interim applicability condition i.e. 25 ktCO_2e/yr limit from all Type III categories.
09.0	21 July 2006	EB 25, Annex 30 Introduce provisions on the treatment of project emissions and include the respective monitoring requirements.
08.0	12 May 2006	EB 24, Para, 64 Introduce the interim applicability condition, i.e. 25kt CO_2e/yr limit for all Type III categories.

Decision Class: Regulatory
Document Type: Standard
Business Function: Methodology
Keywords: fuel switching, simplified methodologies, transport, type (iii) projects

* This document, together with the 'General Guidance' and all other approved SSC methodologies, was part of a single document entitled: Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities until version 07.

History of the document: Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities

Appendix B of the Simplified Modalities and Procedures for Small-Scale CDM project activities contained both the General Guidance and Approved Methodologies until version 07. After version 07 the document was divided into separate documents: 'General Guidance' and separate approved small-scale methodologies (AMS).

Version	*Date*	*Description*
07.0	25 November 2005	EB 22, Para. 59 References to "non-renewable biomass" in Appendix B deleted.
06.0	30 September 2005	EB 21, Annex 22 Guidance on consideration of non-renewable biomass in Type I methodologies, thermal equivalence of Type II GWhe limits included.
05.0	25 February 2005	EB 18, Annex 6 Guidance on 'capacity addition' and 'cofiring' in Type I methodologies and monitoring of methane in AMS-III.D included.
04.0	22 October 2004	EB 16, Annex 2 AMS-II.F was adopted, leakage due to equipment transfer was included in all Type I and Type II methodologies.
03.0	14 June 2004	EB 14, Annex 2 New methodology AMS-III.E was adopted.
02.0	28 November 2003	EB 12, Annex 2 Definition of build margin included in AMS-I.D, minor revisions to AMS-I.A, AMS-III.D, AMS-II.E.
01	21 January 2003	EB 7, Annex 6 Initial adoption. The Board at its seventh meeting noted the adoption by the Conference of the Parties (COP), by its decision 21/CP.8, of simplified modalities and procedures for small-scale CDM project activities (SSC M&P).

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