

CDM-MP88-A05

Draft Small-scale methodology

SSC-III.xx: Hydrogen fuel cell vehicles

Version 01.0

Sectoral scope(s): 07

DRAFT



United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. A request for new methodology “SSC-NM0107: Hydrogen fuel cell logistics truck project in Foshan City”, was submitted by Climate Bridge (Shanghai) Ltd in December 2021.

2. Purpose

2. The proposal submits a new methodology applicable to the project activities that aim to introduce hydrogen fuel cell vehicles replacing baseline vehicles with equivalent capacity.

3. Key issues and proposed solutions

3. The proposed draft methodology is applicable to the project activities introducing hydrogen fuel cell vehicles for passenger and freight transportation. The methodology is applicable only to fleet vehicles such as buses, commuter vans, taxis for public transport and trucks for freight transport, waste collection or food delivery.
4. The hydrogen consumed by project vehicles shall be green hydrogen produced by electrolysis of water using renewable electricity, hydrogen produced by electrolysis of water using grid electricity, or by-product hydrogen that was flared or vented in the absence of the project activity.
5. The use of by-product hydrogen in the project scenario is capped to the maximum quantity of the by-product hydrogen that was flared or vented over last three years prior to the start of the project activity.
6. The project activity shall provide the same level of service provided on comparable routes by the baseline vehicles.

4. Impacts

7. The draft methodology if approved will be first methodology that will allow development of Clean Development Mechanism (CDM) projects using hydrogen fuel cell technology for transport purposes; such projects have strong relevance for reducing greenhouse gas (GHG) emissions in this sector.

5. Subsequent work and timelines

8. The draft version of the methodology is recommended by the Methodologies Panel (MP) for consideration by the Board at its 115th meeting. No further work is envisaged.

6. Recommendations to the Board

9. The MP recommends that the Board adopt this new methodology, to be made effective at the time of the Board’s approval.

TABLE OF CONTENTS	Page
1. INTRODUCTION	4
2. SCOPE, APPLICABILITY, AND ENTRY INTO FORCE	4
2.1. Scope	4
2.2. Applicability	4
2.3. Entry into force	5
2.4. Applicability of sectoral scopes	5
3. NORMATIVE REFERENCES	5
4. DEFINITIONS	6
5. BASELINE METHODOLOGY.....	6
5.1. Project boundary	6
5.2. Baseline.....	7
5.3. Additionality	7
5.3.1. Option 1.....	7
5.3.2. Option 2.....	7
5.4. Baseline emissions.....	7
5.5. Leakage.....	9
5.6. Project emissions	9
5.6.1. Project emissions due to electricity consumption.....	9
5.6.2. Project emissions due to operation of renewable energy plants.....	10
5.6.3. Project emissions due to transportation of hydrogen	10
5.7. Data and parameters not monitored	10
6. MONITORING METHODOLOGY	12
6.1. Data and parameters monitored	13

1. Introduction

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

Table 1. Methodology key elements

Typical project(s)	Operation of hydrogen fuel cell vehicles for providing transportation services
Type of greenhouse gas (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 hydrogen fuel cell vehicles for passenger and freight transportation.

2.2. Applicability

3. Only fleet vehicles are eligible under this methodology. Types of fleet vehicles covered by the methodology include, but are not limited to:
 - (a) Buses, commuter vans or taxis used for public transport;
 - (b) Trucks for freight transport, food delivery or waste collection.
4. For replacement of existing baseline vehicles, the project participants shall demonstrate that the project activity vehicles provide same level of service on comparable routes during the baseline scenario. The 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;
 - (b) The frequency of operations is not decreased by the project activity, the characteristics of the travel route such as distance, start and end points and the route itself are sufficient to service the level of passenger/freight transport previously provided;
 - (c) Project and baseline vehicle categories have comparable passenger or load carrying capacity with a variation of no more than 20 per cent.
5. The types of baseline vehicles to be replaced include, but are not limited to:
 - (a) Fossil fuel-based vehicles;
 - (b) Electric vehicles;
 - (c) Hybrid vehicles with electrical and internal combustion motive systems.
6. The project participant shall demonstrate that double-counting of emission reductions will not occur, e.g. via a contractual agreement with hydrogen fuel cell vehicles

manufacturer(s), hydrogen fuel cell vehicle owner(s), hydrogen fuelling station(s), hydrogen producer(s) and/or renewable energy power plant(s). The project participants shall maintain a comprehensive inventory of project vehicles, including unique identification of the vehicles. The steps undertaken to avoid double-counting shall be documented in the Clean Development Mechanism (CDM) project design document (PDD).

7. Hydrogen consumed by project vehicles shall be from one of the following:
 - (a) Green hydrogen produced by electrolysis of water using renewable electricity, where the renewable electricity would not have been generated in the baseline scenario, e.g. by a greenfield plant within or outside the hydrogen production facility, including electricity procured through a power purchase agreement with a greenfield renewable energy power plant;
 - (b) Hydrogen produced by electrolysis of water using grid electricity;
 - (c) By-product hydrogen that was generated by by-product hydrogen facilities (e.g. chlor-alkali plant) which would have been flared or vented in the absence of the project activity. Historical measurements from the facility which produces by-product hydrogen shall be used to demonstrate that this condition is met.
8. Where by-product hydrogen is used, the quantity of by-product hydrogen that was flared or vented by the by-product hydrogen production facility in the baseline that will be used in the project activity shall be capped to the maximum quantity of hydrogen flared or vented over last three years prior to the start of the project activity.

2.3. Entry into force

9. The date of entry into force is the date of the publication of the EB #### meeting report on ## Month 2022.

2.4. Applicability of sectoral scopes

10. For validation and verification of CDM projects and programme of activities by a designated operational entity (DOE) using this methodology, application of sectoral scope 07 is mandatory.

3. Normative references

11. This methodology is based on the proposed small-scale methodology "SSC-NM107: Emission reduction by hydrogen fuel cell vehicles" submitted by Climate Bridge (Shanghai) Ltd.
12. Project participants shall apply, mutatis mutandis, the "General guidelines for SSC CDM methodologies" and the "TOOL21 Demonstration of additionality of small-scale project activities" (hereinafter referred to as TOOL21), both available at: <<http://cdm.unfccc.int/Reference/Guidclarif/index.html#meth>> mutatis mutandis.
13. This methodology refers to the latest approved versions of the following tools:
 - (a) "ACM0002: Grid-connected electricity generation from renewable sources" (hereinafter referred to as ACM0002);

- (b) “TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation” (hereinafter referred to as TOOL05);
- (c) “TOOL12: Project and leakage emissions from transportation of freight” (hereinafter referred to as TOOL12);
- (d) “TOOL19: Demonstration of additionality of microscale project activities” (hereinafter referred to as TOOL19).

4. Definitions

- 14. The definitions contained in the Glossary of CDM terms shall apply.
- 15. The following definitions shall apply:
 - (a) **By-product hydrogen production facility** – is a facility which produces hydrogen as a by-product (e.g. chlor-alkali plants) that is used in the project activity;
 - (b) **Electric vehicles** – is a category of vehicles that is only powered by a battery that is charged externally using an electric plug;
 - (c) **Fleet vehicles** – are the vehicles that are dedicated to transporting passengers or freight by a specific operator, such as logistic vehicles operated by a courier company or public transport buses operated by a transport company;
 - (d) **Fossil fuel-based vehicles** – are vehicles that use petroleum-based fuels such as petrol, diesel, compressed natural gas or liquified petroleum gas as a fuel for their internal combustion engine;
 - (e) **Green hydrogen** – is an energy carrier that is produced by renewable energy-powered electrolysis of water;
 - (f) **Hydrogen fuel cell vehicles**¹ – is a category of vehicles that uses a propulsion system similar to that of electric vehicles, where energy stored as hydrogen is converted into electricity by a fuel cell;
 - (g) **Hydrogen production facility** – is a facility that produces hydrogen through electrolysis of water using either electricity from renewable energy source or from a grid;
 - (h) **Hybrid vehicles** – is a category of vehicles that combines an internal combustion engine and one or more electric motors. The vehicles may or may not have facility for charging externally using an electric plug.

5. Baseline methodology

5.1. Project boundary

- 16. The project boundary includes:
 - (a) The hydrogen fuel cell vehicles of the project;

¹ Also known as fuel cell electric vehicles (FCEV).

- (b) The geographic boundaries where the project vehicles are operated;
- (c) The hydrogen production facility, including the facilities where hydrogen is produced as a by-product or flared in absence of the project activity;
- (d) Standalone greenfield renewable energy-based power plant(s) that supply renewable electricity, where applicable through a power purchase agreement, to the hydrogen production facility for green hydrogen production;
- (e) The grid-connected power plants supplying electricity to the hydrogen production facility and to the charging station, including the hydrogen storage facility;
- (f) Auxiliary facilities, such as hydrogen fueling stations, that are used by the project vehicles.

5.2. Baseline

- 17. The baseline scenario is the operation of the comparable vehicles (the comparability of baseline and project vehicles to be demonstrated as per paragraph 4 above) that would have been used to provide the same transportation service.
- 18. In case of application of hydrogen fuel cell vehicles to new route(s), the comparable vehicles refer to the category of vehicles that are most commonly used for the same transportation service in the applicable region.

5.3. Additionality

DRAFT

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

5.3.1. 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 TOOL21. The barrier(s) can be demonstrated for buyers/users and/or charging service providers of the hydrogen fuel cell vehicles even if the manufacturer or retailer of the hydrogen fuel cell vehicles is implementing the project.

5.3.2. Option 2

- 21. Demonstrate ex ante that the market penetration of project hydrogen fuel cell vehicles is equal to or smaller than 2.5 per cent of annual sales of the vehicles of the same category (e.g. if project vehicles are hydrogen fuel cell buses, market penetration of hydrogen fuel cell buses is equal to or smaller than 2.5 per cent of all motorized buses, irrespective of the manufacturer) in the applicable region. To determine the penetration of hydrogen fuel cell vehicles, the "Appendix: Determination of penetration of proposed technology/measure" of TOOL19 shall be followed.

5.4. Baseline emissions

- 22. Baseline emissions should be 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:

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

Where:

- BE_y = Baseline emissions in year y (t CO₂)
 $EF_{BL,km,i}$ = Emission factor for baseline vehicle category i (g CO₂/km)
 $TD_{i,y}$ = Annual total distance travelled by project vehicle category i in the year y (km)

23. The emission factor for baseline vehicle category ($EF_{BL,km,i}$) shall be determined ex ante as follows:

$$EF_{BL,km,i} = \sum [(SFC_{i,j} \times NCV_{i,j} \times EF_{i,j}) + (SEC_{i,k} \times EF_{CO2,ELEC,k})] \times IR^t \quad \text{Equation (2)}$$

Where:

- $SFC_{i,j}$ = Specific fuel consumption of baseline vehicle category i consuming fossil fuel type j (g/km)
 $NCV_{i,j}$ = Net calorific value of fossil fuel type j consumed by baseline vehicle category i (J/g)
 $EF_{i,j}$ = Emission factor of fossil fuel type j consumed by baseline vehicle category i (g CO₂/J)
 $SEC_{i,k}$ = Specific electricity consumption of baseline vehicle category i consuming electricity k (kWh/km)
 $EF_{CO2,ELEC,k}$ = Emission factor of electricity consumed by baseline vehicle category k (g CO₂/kWh)
 IR^t = Technology improvement factor for baseline vehicle in year t
 t = Year counter for the annual improvement (dependent on age of data per vehicle category)

24. The specific fuel consumption of baseline vehicle category i ($SFC_{i,j}$) and specific electricity consumption of baseline vehicle category i ($SEC_{i,k}$) shall be determined using one of the following options:

- (a) Option A: The most recent operational data of the vehicles under baseline operational conditions. The average of at least one year of operational data of the vehicle(s) under baseline operating conditions, if available. Otherwise:
- (b) Option B: Manufacturer's specification of the top 20 per cent of comparable vehicles operated for passenger/freight transportation in the project region;
- (c) Option C: Latest publicly available statistics, such as host country statistics or reports (released by transportation department or other authorities), relevant industry association reports or peer-reviewed literature, advanced value in relevant national standards, Intergovernmental Panel on Climate Change (IPCC), or other international data.

5.5. Leakage

25. No Leakage is considered under this methodology.

5.6. Project emissions

26. Project emissions shall be calculated as follows.

$$PE_y = PE_{elec,y} + PE_{RE,y} + PE_{trans,y} \quad \text{Equation (3)}$$

Where:

PE_y	= Project emissions in year y (t CO ₂)
$PE_{elec,y}$	= Project emissions due to grid electricity consumption in year y (t CO ₂)
$PE_{RE,y}$	= Project emissions due to operation of renewable energy plants supplying electricity to the hydrogen production facility (t CO ₂)
$PE_{trans,y}$	= Project emissions due to transportation and storage of hydrogen to be used in the project activity in year y (t CO ₂)

5.6.1. Project emissions due to electricity consumption

27. Project emissions due to electricity consumption for hydrogen production when hydrogen is produced using grid electricity and electricity consumption by the storage facility of hydrogen at the charging / fuel stations are calculated as follows:

$$PE_{elec,y} = PE_{elec,p,y} + PE_{elec,cs,y} \quad \text{Equation (4)}$$

Where:

$PE_{elec,p,y}$	= Project emissions due to grid electricity consumption for hydrogen production in year y (t CO ₂)
$PE_{elec,cs,y}$	= Project emissions due to electricity consumption for compression and storage of hydrogen the hydrogen charging / fuel stations in year y (t CO ₂)

5.6.1.1. Project emissions due to hydrogen production

28. The project emissions due to hydrogen production are calculated as follows:

$$PE_{elec,p,y} = EC_{H2,p,y} \times EF_{grid,y} \quad \text{Equation (5)}$$

Where:

$EC_{H2,p,y}$	= Electricity consumption by the green hydrogen production facility in year y (MWh)
$EF_{grid,y}$	= Grid emission factor in year y (t CO ₂ /MWh)

5.6.1.2. Project emissions due to hydrogen compression and storage

29. The project emissions due to electricity consumption by the hydrogen compression and storage at the hydrogen charging / fuel stations are calculated as follows:

$$PE_{elec,cs,y} = EC_{H2,cs,y} \times EF_y \quad \text{Equation (6)}$$

Where:

- $EC_{H2,cs,y}$ = Electricity consumption by the hydrogen compression and storage at the hydrogen charging / fuel stations in year y (MWh)
 EF_y = Electricity emission factor in year y (t CO₂/MWh)

30. In case the storage facility uses renewable electricity, the project emissions due to electricity consumption at storage facility are considered as zero.

5.6.2. Project emissions due to operation of renewable energy plants

31. In case of dedicated renewable energy supply from a renewable source such as geothermal power plant and/or hydroelectric power plant, project emissions shall include emissions due to operation of these plants. The project emissions shall be calculated as per the requirements provided under ACM0002.

5.6.3. Project emissions due to transportation of hydrogen

32. Project emissions due to transportation of green hydrogen shall be calculated as per requirements provided under TOOL12 if the transportation distance is more than 200 km; otherwise they can be neglected.

5.7. Data and parameters not monitored

33. In addition to the parameters listed in the tables below, the provisions on data and parameters not monitored in the tools referred to in this methodology apply.

Data / Parameter table 1.

Data / Parameter:	$EF_{BL,km,i}$ or $EF_{BL,km,k}$
Data unit:	g CO ₂ /km
Description:	Emission factor for baseline vehicle category i or baseline vehicle category k
Source of data:	Determined as per paragraph 22
Any comment:	Fixed ex ante at the time of validation and updated once for every subsequent crediting period

Data / Parameter table 2.

Data / Parameter:	$SFC_{i,j}$
Data unit:	g/km
Description:	Specific fuel consumption of baseline vehicle category i consuming fossil fuel type j

Source of data:	Most recent operational data, or manufacturer's specification, or publicly available statistics
Any comment:	-

Data / Parameter table 3.

Data / Parameter:	$NCV_{i,j}$
Data unit:	J/g
Description:	Net calorific value of fossil fuel type j consumed by baseline vehicle category i
Source of data:	The following data sources' latest available may be used, in order of priority: (a) Values provided by the fuel supplier; (b) Regional or national default values. IPCC default values at the upper limits of the 95 per cent confidence intervals as provided in Table 1.2 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Any comment:	-

Data / Parameter table 4.

Data / Parameter:	$EF_{i,j}$
Data unit:	g CO ₂ /J
Description:	Emission factor of fossil fuel type j consumed by baseline vehicle category i
Source of data:	The following data sources' latest available may be used, in order of priority: (a) Values provided by the fuel supplier; (b) Regional or national default values. IPCC default values at the upper limits of the 95 per cent confidence intervals as provided in Table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories
Any comment:	-

Data / Parameter table 5.

Data / Parameter:	$SEC_{i,k}$
Data unit:	kWh/km
Description:	Specific electricity consumption of baseline vehicle category i consuming electricity k
Source of data:	Most recent operational data, or manufacturer's specification, or publicly available statistics
Any comment:	-

Data / Parameter table 6.

Data / Parameter:	$EF_{CO_2,ELEC,k}$
Data unit:	g CO ₂ /kWh
Description:	Emission factor of electricity consumed by baseline vehicle category <i>k</i>
Source of data:	Emission factor of electricity consumed by baseline vehicle is determined using one of the following options: (a) If the electricity for charging the baseline vehicle is supplied by renewable power plant, emission factor is 0; (b) If grid electricity is used, emission factor can be calculated as per requirements under TOOL05
Any comment:	-

Data / Parameter table 7.

Data / Parameter:	IR^t
Data unit:	-
Description:	Technology improvement factor for baseline vehicle in year <i>t</i>
Source of data:	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
Any comment:	-

Data / Parameter table 8.

Data / Parameter:	By-product hydrogen vented or flared in the baseline scenario
Data unit:	Volume or mass unit
Description:	Maximum value of the by-product hydrogen that was vented or flared in the baseline scenario
Source of data:	Historical measurements from the by-product hydrogen production facility
Any comment:	The value is fixed at the time of validation and is based on the last three years of value prior to the start of the project activity. The quantity of the by-product hydrogen that will be used in the project scenario shall not be more than this value

6. Monitoring methodology

34. 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.

6.1. Data and parameters monitored

Data / Parameter table 9.

Data / Parameter:	By-product hydrogen used in the project scenario
Data unit:	Volume or mass unit
Description:	The by-product hydrogen that is used in the project vehicles
Source of data:	Measurements from the hydrogen charging station
Measurement procedures (if any):	Measured using a flow meter
Monitoring frequency:	Continuous monitoring and at least monthly recording
QA/QC procedures:	Cross checked with the quantity of the by-product hydrogen that was purchased from the project industrial facility
Any comment:	The quantity of the by-product hydrogen that will be used in the project scenario shall not be more than this value

Data / Parameter table 10.

Data / Parameter:	$TD_{i,y}$
Data unit:	km
Description:	Annual total distance travelled by project vehicle category i in the year y
Source of data:	Measurement
Measurement procedures (if any):	Monitor travel distance of every vehicle through Vehicle odometer or any other appropriate sources (e.g. on-line sources)
Monitoring frequency:	Continuous monitoring and at least monthly recording
QA/QC procedures:	Cross-checked with GPS data if available
Any comment:	-

Data / Parameter table 11.

Data / Parameter:	$EF_{grid,y}$ or EF_y
Data unit:	t CO ₂ /MWh
Description:	Grid or electricity emission factor in year y
Source of data:	Grid emission factor is determined as per requirements under TOOL05
Measurement procedures (if any):	As per requirements under TOOL05
Monitoring frequency:	As per requirements under TOOL05
QA/QC procedures:	As per requirements under TOOL05
Any comment:	-

Data / Parameter table 12.

Data / Parameter:	$EC_{H2,p,y}$
Data unit:	MWh
Description:	Electricity consumption by the hydrogen production facility in year y

Source of data:	Measurement
Measurement procedures (if any):	As per requirements under TOOL05 for parameter $EC_{P,j,y}$
Monitoring frequency:	As per requirements under TOOL05 for parameter $EC_{P,j,y}$
QA/QC procedures:	As per requirements under TOOL05 for parameter $EC_{P,j,y}$
Any comment:	-

Data / Parameter table 13.

Data / Parameter:	$EC_{H_2,cs,y}$
Data unit:	MWh
Description:	Electricity consumption by the hydrogen compression and storage facility at the hydrogen charging / fuel stations in year y
Source of data:	Measurement
Measurement procedures (if any):	As per requirements under TOOL05 for parameter $EC_{P,j,y}$
Monitoring frequency:	As per requirements under TOOL05 for parameter $EC_{P,j,y}$
QA/QC procedures:	As per requirements under TOOL05 for parameter $EC_{P,j,y}$
Any comment:	-

DRAFT
 Document information

<i>Version</i>	<i>Date</i>	<i>Description</i>
01.0	13 July 2022	MP 88, Annex 5 To be considered by the Board at EB 115.

Decision Class: Regulatory
 Document Type: Standard
 Business Function: Methodology
 Keywords: Hydrogen fuel cell vehicles