Joint Crediting Mechanism Approved Methodology VN_AM001

"Transportation energy efficiency activities by installing digital tachograph systems"

A. Title of the methodology

Transportation energy efficiency activities by installing digital tachograph systems, Version ~~1~~2.0

B. Terms and definitions

Terms	Definitions
Digital tachograph system	A system consists of digital tachograph device and tachograph data analysis system, whose function includes but not limited to the followings: (a) Provides real-time feedback, such as alert sounds and flashing lights, during instances of inefficient driving, following which the driver adjust to a more efficient driving pattern in order to deactivate the instant feedback; (b) Continuously records the vehicle's operation including time, position, speed, acceleration, etc. for all the time of operation; and (c) Automatically analyzes and provides a graphical representation of a driver's performance based on recorded data in order to further improve driving efficiency.
Fuel efficiency	Energy efficiency of a particular vehicle given as a ratio of fuel consumed per unit of distance travelled. [kL/km]
Similar type of vehicles	Vehicles that have the same capacity (e.g. 2 t, 10 t, 40 t) and meet the same emission standards (e.g. EURO2, EURO3) and equipped with the same fuel efficiency technologies (e.g. radial tires, wind deflector, tire pressure monitoring system, fuel consumption monitoring system) as the newly added or replaced vehicles.

C. Summary of the methodology

Items	Summary
GHG emission reduction measures	Improvement of driving efficiency by installation of digital tachograph system to freight vehicle fleets providing to the drivers a real-time feedback (e.g. alert sounds and flashing lights, etc.) against inefficient driving. Further improvement of driving efficiency by graphical representation based on automatic analysis of drivers' performance.
Calculation of reference emissions	The reference emissions are calculated for each freight vehicle by multiplying reference fuel efficiency of freight vehicle, project distance travelled by that freight vehicle, net calorific value and CO_2 emission factor of fuel used by freight vehicles.
Calculation of project emissions	Project emissions are calculated for each freight vehicle on the basis of monitored fuel consumption, net calorific value and CO_2 emission factor of fuel used by freight vehicles.
Monitoring parameters	● Project fuel consumption by each freight vehicle ● Project distance travelled by each freight vehicle

D. Eligibility criteria

This methodology is applicable to projects that satisfy all of the following criteria.

Criterion 1	This methodology applies to freight vehicle fleets to which a digital tachograph system has been installed.
Criterion 2	Data of fuel consumption and distance travelled before activation of digital tachograph system is available for each freight vehicle~~.~~, except for the cases of application of Option (c) to the reference fuel efficiency ($\eta_{RF,i}$) in Section F.2.~~.~~ The data is to be collected for at least 60 days within 4 months of lower monthly mean temperature of the year (November, December, January and February).
Criterion 3	The project includes feedback of a driver's performance with the graphical representation to the driver regularly, at least once in three months.
Criterion 4	The project does not involve a fuel switch in existing freight vehicles, except for an optional switch to biofuel blends where the blending ratio is not greater than 20% by volume, in which case emission reductions are discounted by the percentage of biofuel in the blend.
Criterion 5	The project participants identify each freight vehicle included in the project,

	and ensure that the type of service of the freight vehicle is the same before and during the project (e.g. refrigeration vehicle remains as a refrigeration vehicle, etc.).
Criterion 6	A plan to present new reference data for freight vehicles of new routes in case route changes have occurred due to construction of new expressways or to modal shift after the introduction of the project is prepared.

E. Emission Sources and GHG types

Reference emissions	
Emission sources	GHG types
Consumption of fossil fuel by freight vehicles	CO_2
Project emissions	
Emission sources	GHG types
Consumption of fossil fuel by freight vehicles	CO_2

F. Establishment and calculation of reference emissions

F.1. Establishment of reference emissions

Reference emissions are calculated for each freight vehicle by multiplying reference fuel efficiency of the freight vehicle, project distance travelled by that freight vehicle, net calorific value of the fuel used, and the CO_2 emission factor of the fuel used.

The reference fuel efficiency is determined conservatively for each freight vehicle based on actual measurement before activation of digital tachograph system in the following manner to ensure the net emission reductions.

1. Due to the use of air conditioners, fuel efficiency of the freight vehicle tends to worsen as the atmospheric temperature becomes higher.
2. Selecting data for calculation of reference fuel efficiency during the months with lower temperature will result in improved fuel efficiency, leading to the ensuring of the net emission reduction.
3. Therefore, data to determine reference fuel efficiency is collected for at least 60 days within 4 months of lower monthly mean temperature of the year. Based on average temperatures in Hanoi, Da Nang and Ho Chi Minh City, these 4 months will be November, December, January and February.

F.2. Calculation of reference emissions

$$\mathbf{RE_p} = \sum_{\mathbf{i}} \mathbf{RE_{i,p}}$$

RE_p : Reference emissions during the period *p* [tCO_2/p]

$RE_{i,p}$: Reference emissions of freight vehicle *i* during the period *p* [tCO_2/p]

$$\mathbf{RE_{i,p}} = \boldsymbol{\eta}_{\mathbf{RE,i}} \times \mathbf{PD_{i,p}} \times \mathbf{NCV_i} \times \mathbf{EF_{CO2,i}}$$

$RE_{i,p}$: Reference emissions of freight vehicle *i* during the period *p* [tCO_2/p]

$\eta_{RE,i}$: Reference fuel efficiency of freight vehicle *i* [kL/km]

$PD_{i,p}$: Project distance travelled by freight vehicle *i* during the period *p* [km/p]

NCV_i : Net calorific value of fuel used by freight vehicle *i* [GJ/kL]

$EF_{CO2,i}$: CO_2 emission factor of fuel used by freight vehicle *i* [tCO_2/GJ]

$$\boldsymbol{\eta}_{\mathbf{RE,i}} = \mathbf{FC_{i,before}} \div \mathbf{D_{i,before}}$$

$\eta_{RE,i}$: Reference fuel efficiency of freight vehicle *i* [kL/km]

$FC_{i,before}$: Fuel consumption by freight vehicle *i* measured during the period *b* before activation of digital tachograph system [kL/b]

$D_{i,before}$: Distance travelled by freight vehicle *i* measured during the period *b* before activation of digital tachograph system [km/b]

[New addition and replacement of freight vehicles]

The reference fuel efficiency ($\eta_{RE,i}$) for freight vehicles newly added to the fleet and added to replace the existing freight vehicles after the start of the project is determined using one of the following options:

(a) The reference fuel efficiency is estimated by averaging the reference fuel efficiencies of vehicles in the fleet which are the same models and travel the same route as the newly added vehicle. Routes with the same origin and destination (O.D.) are considered as the same routes. The O.D. can be city names (e.g. Hanoi, HCMC, etc.) in case that the vehicle travels between cities or more detailed area names in case that the vehicles travel within a city;

(b) If data cannot be obtained from vehicles with the same model and the same routes, the reference fuel efficiency is determined using obtained data from newly added freight vehicles before activation of digital tachograph system for at least 60 days within 4 months of lower monthly mean temperature of the year (November, December, January and February~~).~~); or

(c) If neither option (a) nor (b) can be applied, the reference fuel efficiency is estimated by

averaging the fuel efficiency values of the highest 20 % fuel efficiency vehicles of the similar type of vehicles in the fleet before activation of digital tachograph system, as determined according to travel distance of each vehicle for at least 60 days within 4 months of lower monthly mean temperature of the year (November, December, January and February).

[Construction of new expressways or a modal shift]
In case route changes have occurred due to construction of new expressways or to modal shift (e.g. shift from truck to rail) after the introduction of the project, project participant present new reference data for freight vehicles of new routes as per the provisions for new addition and replacement of freight vehicles.

[(Recommendation) Estimation of reference emissions using freight ton-km]
Project participants are recommended to estimate reference emissions using reference fuel efficiency of freight vehicles calculated with freight ton-km data obtained before activation of digital tachograph system to compare reference emissions calculated with reference fuel efficiency of travel distance.

G. Calculation of project emissions

$$\mathbf{PE_p} = \sum_{\mathbf{i}} \mathbf{PE_{i,p}}$$

PE_p : Project emissions during the period *p* [tCO_2/p]
$PE_{i,p}$: Project emissions of freight vehicle *i* during the period *p* [tCO_2/p]

$$\mathbf{PE_{i,p}} = \mathbf{PFC_{i,p}} \times \mathbf{NCV_i} \times \mathbf{EF_{CO2,i}}$$

$PE_{i,p}$: Project emissions of freight vehicle *i* during the period *p* [tCO_2/p]
$PFC_{i,p}$: Project fuel consumption of freight vehicle *i* during the period *p* [kL/p]
NCV_i : Net calorific value of fuel used by freight vehicle *i* [GJ/kL]
$EF_{CO2,i}$: CO_2 emission factor of fuel used by freight vehicle *i* [tCO_2/GJ]

H. Calculation of emissions reductions

Taking into account possibilities of emission reductions from other factors than installation of

digital tachograph system, emission reductions for the project is limited to 10% of the reference emissions.

$$\mathbf{ER_p = min\left(RE_p - PE_p, 0.1 \times RE_p\right)}$$

ER_p : Emission reductions during the period *p* [tCO_2/p]

RE_p : Reference emissions during the period *p* [tCO_2/p]

PE_p : Project emissions during the period *p* [tCO_2/p]

I. Data and parameters fixed *ex ante*

The source of each data and parameter fixed *ex ante* is listed as below.

Parameter	Description of data	Source
NCV_i	Net calorific value of fuel used by freight vehicle *i* [GJ/kL]	Country specific data or IPCC default value from "2006 IPCC Guidelines for National Greenhouse Gas Inventory". Lower limit value of the default net calorific value is applied.
$EF_{CO2,i}$	CO_2 emission factor of fuel used by freight vehicle *i* [tCO_2/GJ]	Country specific data or IPCC default value from "2006 IPCC Guidelines for National Greenhouse Gas Inventory". Lower limit value of the default CO_2 emission factor is applied.
$FC_{i,before}$	Fuel consumption by freight vehicle *i* measured during the period *b* before activation of digital tachograph system [kL/b]	Purchase bills or consumption records
$D_{i,before}$	Distance travelled by freight vehicle *i* measured during the period *b* before activation of digital tachograph system [km/b]	Driver logs
$\eta_{RE,i}$	Reference fuel efficiency of freight vehicle *i* [kL/km]	Calculated data before activation of digital tachograph system

History of the document

Version	Date	Contents revised
02.0	20 October 2016	JC5, Annex 8 ● Addition of a new option for determining the reference emissions for freight vehicles newly added to the fleet or added to replace existing freight vehicles. ● Revision of the description of the Criterion 2.

		● Addition of the definition of "Similar type of vehicles".
01.0	14 January 2015	JC3, Annex 1 Initial approval.

Monitoring Plan Sheet (Input Sheet) [Attachment to Project Design Document]

Table 1: Parameters to be monitored *ex post*

(a)	Monitoring point No.	(1)	(2)
(b)	Parameters	$PFC_{i,p}$	$PD_{i,p}$
(c)	Description of data	Project fuel consumption of freight vehicle *i* during the period *p*	Project distance travelled by freight vehicle *i* during the period *p*
(e)	Units	kL/p	km/p
(f)	Monitoring option	Option B/C	Option C
(g)	Source of data	purchace bill/fuel meter/company record	odometer/data server
(h)	Measurement methods and procedures	Purchase or consumption records or fuel consumption data. If the fuel consumption is determined by fuel flow sensors (meters), they must be calibrated.	Driver logs or records by GPS tracking system
(i)	Monitoring frequency	Monthly	Continuous
(j)	Other comments		
(d)	Estimated Value of vehicle i		
	i=1		
	i=2		
	i=3		
	i=4		
	i=5		
	i=6		
	i=7		
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	i=41		
	i=42		
	i=43		

Table 2: Project-specific parameters to be fixed *ex ante*

(a)	Parameters	NCV_i	$EF_{CO2,i}$	$FC_{i,before}$	$D_{i,before}$	$\eta_{RE,i}$
(b)	Description of data	Net calorific value of fuel used by freight vehicle *i*	CO_2 emission factor of fuel used by freight vehicle *i*	Fuel consumption by freight vehicle *i* measured during the period *b* before activation of digital tachograph system	Distance travelled by freight vehicle *i* measured during the period *b* before activation of digital tachograph system	Reference fuel efficiency of freight vehicle *i*
(d)	Units	GJ/kL	tCO_2/GJ	kL/b	km/b	kL/km
(e)	Source of data	Country specific data or IPCC default value from "2006 IPCC Guidelines for National Greenhouse Gas Inventory". Lower limit value of the default net calorific value is applied.	Country specific data or IPCC default value from "2006 IPCC Guidelines for National Greenhouse Gas Inventory". Lower limit value of the default CO_2 emission factor is applied.	Purchase bills or consumption records~~:~~ ~~Data is obtained from newly added freight vehicles or comparable~~ for the freight vehicle~~s~~ before activation of digital tachograph system for at least 60 days within 4 months of lower monthly mean temperature of the year (November, December, January and February). For the existing freight vehicle, data of the same vehicle is applied. For the freight vehicle newly added to the fleet or added to replace the existing freight vehicle, data of the vehicle specified in section F.2. is applied.	Driver logs ~~measured:~~ ~~Data is obtained from newly added freight vehicles or comparable~~ of the freight vehicle~~s~~ before activation of digital tachograph system for at least 60 days within 4 months of lower monthly mean temperature of the year (November, December, January and February). For the existing freight vehicle, data of the same vehicle is applied. For the freight vehicle newly added to the fleet or added to replace the existing freight vehicle, data of the vehicle specified in section F.2. is applied.	Calculated data before activation of digital tachograph system
(f)	Other comments					
(c)	Estimated value of vehicle i					
	i=1					-
	i=2					-
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	i=4					-
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	i=42					-
	i=43					-

Table3: *Ex-ante* estimation of each CO_2 emission reduction

(a)	Parameters	RE_p	PE_p
(b)	Description of data	Reference emissions during the period *p*	Project emissions during the period *p*
(d)	Units	$[tCO_2/p]$	$[tCO_2/p]$
(c)	Estimated value of vehicle i		
	i=1	-	-
	i=2	-	-
	i=3	-	-
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	i=42	-	-
	i=43	-	-

Table3: *Ex-ante* estimation of CO_2 emission reductions

CO_2 emission reductions	Units
0	tCO_2/p

[Monitoring option]

Option A	Based on public data which is measured by entities other than the project participants (Data used: publicly recognized data such as statistical data and specifications)
Option B	Based on the amount of transaction which is measured directly using measuring equipments (Data used: commercial evidence such as invoices)
Option C	Based on the actual measurement using measuring equipments (Data used: measured values)

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Monitoring Plan Sheet (Calculation Process Sheet) [Attachment to Project Design Document]

1. Calculations for emission reductions	Fuel type	Value	Units	Parameter
Emission reductions during the period *p*	N/A	0.0	tCO_2/p	ER_p
2. Selected default values, etc.				
3. Calculations for reference emissions				
Reference emissions during the period *p*	N/A	0.0	tCO_2/p	RE_p
4. Calculations of the project emissions				
Project emissions during the period *p*	N/A	0.0	tCO_2/p	PE_p

Monitoring Structure Sheet [Attachment to Project Design Document]

Responsible personnel	Role

Monitoring Report Sheet (Input Sheet) [For verification]

Table 1: Parameters monitored *ex post*

(a)	Monitoring period		
(b)	Monitoring point No.	(1)	(2)
(c)	Parameters	$PFC_{i,p}$	$PD_{i,p}$
(d)	Description of data	Project fuel consumption of freight vehicle *i* during the period *p*	Project distance travelled by freight vehicle *i* during the period *p*
(f)	Units	kL/p	km/p
(g)	Monitoring option	Option B/C	Option C
(h)	Source of data	purchace bill/fuel meter/company record	odometer/data server
(i)	Measurement methods and procedures	Purchase or consumption records or fuel consumption data. If the fuel consumption is determined by fuel flow sensors (meters), they must be calibrated.	Driver logs or records by GPS tracking system
(j)	Monitoring frequency	Monthly	Continuous
(k)	Other comments		
(e)	Monitored Value of vehicle i		
	i=1		
	i=2		
	i=3		
	i=4		
	i=5		
	i=6		
	i=7		
	i=8		
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	i=26		
	i=27		
	i=28		
	i=29		
	i=30		
	i=31		
	i=32		
	i=33		
	i=34		
	i=35		
	i=36		
	i=37		
	i=38		
	i=39		
	i=40		
	i=41		

Table 2: Project-specific parameters fixed *ex ante*

(a)	Parameters	NCV_i	$EF_{CO2,i}$	$FC_{i,before}$	$D_{i,before}$	$\eta_{RE,i}$
(b)	Description of data	Net calorific value of fuel used by freight vehicle *i*	CO_2 emission factor of fuel used by freight vehicle *i*	Fuel consumption by freight vehicle *i* measured during the period *b* before activation of digital tachograph system	Distance travelled by freight vehicle *i* measured during the period *b* before activation of digital tachograph system	Reference fuel efficiency of freight vehicle *i*
(d)	Units	GJ/kL	tCO_2/GJ	kL/b	km/b	kL/km
(e)	Source of data	Country specific data or IPCC default value from "2006 IPCC Guidelines for National Greenhouse Gas Inventory". Lower limit value of the default net calorific value is applied.	Country specific data or IPCC default value from "2006 IPCC Guidelines for National Greenhouse Gas Inventory". Lower limit value of the default CO2 emission factor is applied.	Purchase bills or consumption recordss~~:~~ ~~Data is obtained from newly added freight vehicles or comparable~~ for the freight vehicle~~s~~ before activation of digital tachograph system for at least 60 days within 4 months of lower monthly mean temperature of the year (November, December, January and February). For the existing freight vehicle, data of the same vehicle is applied. For the freight vehicle newly added to the fleet or added to replace the existing freight vehicle, data of the vehicle specified in section F.2. is applied.	Driver logs ~~measured:~~ ~~Data is obtained from newly added freight vehicles or comparable~~ of the freight vehicle~~s~~ before activation of digital tachograph system for at least 60 days within 4 months of lower monthly mean temperature of the year (November, December, January and February). For the existing freight vehicle, data of the same vehicle is applied. For the freight vehicle newly added to the fleet or added to replace the existing freight vehicle, data of the vehicle specified in section F.2. is applied.	Calculated data before activation of digital tachograph system
(f)	Other comments					
(c)	Estimated value of vehicle i					
	i=1					-
	i=2					-
	i=3					-
	i=4					-
	i=5					-
	i=6					-
	i=7					-
	i=8					-
	i=9					-
	i=10					-
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	i=12					-
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	i=14					-
	i=15					-
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	i=17					-
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	i=21					-
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	i=33					-
	i=34					-
	i=35					-
	i=36					-
	i=37					-
	i=38					-
	i=39					-
	i=40					-
	i=41					-

Table3: *Ex-post* calculation of CO_2 emission reductions

(a)	Parameters	RE_p	PE_p
(b)	Description of data	Reference emissions during the period *p*	Project emissions during the period *p*
(d)	Units	$[tCO_2/p]$	$[tCO_2/p]$
(c)	Estimated value of vehicle i		
	i=1	-	-
	i=2	-	-
	i=3	-	-
	i=4	-	-
	i=5	-	-
	i=6	-	-
	i=7	-	-
	i=8	-	-
	i=9	-	-
	i=10	-	-
	i=11	-	-
	i=12	-	-
	i=13	-	-
	i=14	-	-
	i=15	-	-
	i=16	-	-
	i=17	-	-
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	i=19	-	-
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	i=29	-	-
	i=30	-	-
	i=31	-	-
	i=32	-	-
	i=33	-	-
	i=34	-	-
	i=35	-	-
	i=36	-	-
	i=37	-	-
	i=38	-	-
	i=39	-	-
	i=40	-	-
	i=41	-	-

Table3: *Ex-post* calculation of CO_2 emission reductions

Monitoring Period	CO_2 emission reductions	Units
	0	tCO_2/p

[Monitoring option]

Option A	Based on public data which is measured by entities other than the project participants (Data used: publicly recognized data such as statistical data and specifications)
Option B	Based on the amount of transaction which is measured directly using measuring equipments (Data used: commercial evidence such as invoices)
Option C	Based on the actual measurement using measuring equipments (Data used: measured values)

i=42			
i=43			
i=44			
i=45			
i=46			
i=47			
i=48			
i=49			
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i=150			

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i=150					-

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i=149	-	-	
i=150	-	-	

Monitoring Report Sheet (Calculation Process Sheet) [For verification]

1. Calculations for emission reductions	Fuel type	ɔecific param	Units	Parameter
Emission reductions during the period *p*	N/A	0.0	tCO_2/p	ER_p
2. Selected default values, etc.				
3. Calculations for reference emissions				
Reference emissions during the period *p*	N/A	0.0	tCO_2/p	RE_p
4. Calculations of the project emissions				
Project emissions during the period *p*	N/A	0.0	tCO_2/p	PE_p