VCS | VERIFIED CARBON STANDARD

A Global Benchmark for Carbon

Approved VCS Methodology
VM0020

Version 1.0

Sectoral Scopes 3 and 7

Transport Energy Efficiency from Lightweight Pallets

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Relationship to Approved or Pending Methodologies

Justification for a new methodology is provided below according to the procedure and requirements of the VCS document "Methodology Approval Process".

List of Approved or Pending Methodologies under Same Sectoral Scopes:

GHG Program	Sectoral Scope	Reference Number	Name	Status
VCS	3	VM0008	Methodology for Weatherization of Single and Multi-Family Buildings	Approved
VCS	3	VM0013	Baseline and Monitoring Methodology for the Reduction of Jet Engine Emissions through the Use of Engine Washing Technology	Approved
VCS	7	N/A	Methodology for Efficiency Improvements HDV's and Mobile Machinery	First Assessment
VCS	7	N/A	Methodology for Determining GHG Emission Reductions Through Bicycle Sharing Projects	Second Assessment
VCS	7	VM0019	Methodology for fuel switching from gasoline to ethanol in flex-fuel vehicle fleets	Approved
VCS	4, 6, 7, 13	VM0018	Energy Efficiency and Solid Waste Diversion Activities within a Sustainable Community	Approved
CDM	3	AM0017	Steam System Efficiency Improvements by Replacing Steam Traps and Returning Condensate	Approved
CDM	3	AM0018	Baseline Methodology for Steam Optimization Systems	Approved
CDM	3	AM0020	Baseline Methodology for Water Pumping Efficiency Improvements	Approved
CDM	3	AM0046	Distribution of Efficient Light Bulbs to Households	Approved
CDM	3	AM0060	Power Saving through Replacement by Energy Efficient Chillers	Approved
CDM	3,9	AM0068	Methodology for Improved Energy Efficiency by Modifying Ferroalloy Production Facility	Approved
CDM	3	AM0086	Installation of Zero Energy Water Purifier for Safe Drinking Water Application	Approved
CDM	3	AM0088	Air Separation using Cryogenic Energy Recovered from the Vaporization of LNG	Approved
CDM	3	AM0091	Energy efficiency and fuel switching measures in new buildings	Approved
CDM	3	AMS-II.C.	Demand-Side Energy Efficiency Activities for Specific Technologies	Approved
CDM	3	AMS-II.E.	Energy Efficiency and Fuel Switching Measures for Buildings	Approved

GHG Program	Sectoral Scope	Reference Number	Name	Status
CDM	3	AMS-II.F.	Energy Efficiency and Fuel Switching Measures for Agricultural Facilities and Activities	Approved
CDM	3	AMS-II.G.	Energy Efficiency Measures in Thermal Applications of Non-Renewable Biomass	Approved
CDM	3	AMS-II.J.	Demand-Side Activities for Efficient Lighting Technologies	Approved
CDM	3	AMS-II.K.	Installation of Co-generation or Tri-generation Systems Supplying Energy to Commercial Building	Approved
CDM	3	AMS-II.L.	Demand-side activities for efficient outdoor and street lighting technologies	Approved
CDM	3	AMS-II.M.	Demand-side energy efficiency activities for installation of low-flow hot water savings devices	Approved
CDM	3,11	AMS-III.X.	Energy Efficiency and HFC-134a Recovery in Residential Refrigerators	Approved
CDM	3	AMS-III.AE.	Energy Efficiency and Renewable Energy Measures in New Residential Buildings	Approved
CDM	3	AMS-III.AL.	Conversion from Single Cycle to Combined Cycle Power Generation	Approved
CDM	3	AMS-III.AV.	Low greenhouse gas emitting water purification systems	Approved
CDM	7	AM0031	Baseline Methodology for Bus Rapid Transit Projects	Approved
CDM	7	AM0090	Modal Shift in Transportation of Cargo from Road Transportation to Water or Rail Transportation	Approved
CDM	7	ACM0016	Baseline Methodology for Mass Rapid Transit Projects	Approved
CDM	7	AMS-III.C.	Emission Reductions by Electric and Hybrid Vehicles	Approved
CDM	7	AMS-III.S.	Introduction of Low-Emission Vehicles/Technologies to Commercial Vehicle Fleets	Approved
CDM	7	AMS-III.T.	Plant Oil Production and Use for Transport Applications	Approved
CDM	7	AMS-III.U.	Cable Cars for Mass Rapid Transit System (MRTS)	Approved
CDM	7	AMS-III.AA.	Transportation Energy Efficiency Activities Using Retrofit Technologies	Approved
CDM	7	AMS-III.AK.	Biodiesel Production and Use for Transport Applications	Approved
CDM	7	AMS-III.AP.	Transport Energy Efficiency Activities Using Post-Fit Idling Stop Device	Approved

GHG Program	Sectoral Scope	Reference Number	Name	Status
CDM	7	AMS-III.AQ.	Introduction of Bio-CNG in Transportation Activities	Approved
CDM	7	AMS-III.AT.	Transportation energy efficiency activities installing digital tachograph systems to commercial freight transport fleets	Approved

This methodology applies to project activities that are not broadly similar to an activity or measure covered by an existing approved or pending methodology.

None of the similar methodologies identified above could be revised without substantial changes to the section on project boundary.

None of the similar methodologies identified above could be revised without the addition of new procedures or scenarios to more than half of its sections.

Table of Contents

1 SOURCES

The VCS Methodology Template was used to develop this methodology.

This Methodology is based on elements of the following CDM methodologies:

- AMS-III.AA. "Transportation Energy Efficiency Activities using Retrofit Technologies" (Section 4)
- AMS-III.S. "Introduction of Low Emission Vehicles/Technologies to Commercial Vehicle Fleets" (Sections 4 and 8)
- ACM0017 "Production of Biodiesel for Use as Fuel" (Sections 6, 8.3, and 9.2)
- AM0090 "Modal Shift in Transportation of Cargo from Road Transportation to Water or Rail Transportation" (Sections 6 and 8)

This methodology refers to the latest approved version of the following CDM tool:

- *Combined tool to identify the baseline scenario and demonstrate additionality* (Section 6 Procedure for Determining the Baseline Scenario)[1]

This methodology refers to elements of the latest approved version of the following CDM tool:

- *Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion* (Section 9.2 Data and Parameters Monitored, including: "Source of data", "Description of measurement methods and procedures to be applied", "QA/QC procedures to be applied")[2]

2 SUMMARY DESCRIPTION OF THE METHODOLOGY

Pallets are flat, portable structures that support goods during handling, transportation and storage. This methodology outlines procedures to estimate the avoided net greenhouse gas (GHG) emissions resulting from project activities involving the use of pallets that are lighter in weight than their conventional alternatives for freight transport. Typical GHG reduction projects with lightweight pallets involve:

a) Replacing an existing fleet of conventional wood pallets with lightweight pallets, or
b) Setting up a new fleet of pallets using lightweight pallets.

In both cases, the baseline would be the same fleet of conventional pallets. Projects achieve GHG emission reductions through reducing the total weight of goods transported, hence reducing fuel consumption and associated GHG emissions.

This methodology provides procedures to select the baseline from amongst plausible scenarios and provides methods to transparently estimate the baseline GHG emissions. Project emissions are

[1] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-v4.0.0.pdf

[2] http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-03-v2.pdf

quantified by monitoring the fuel consumption by captive truck fleets transporting freight using lightweight pallets.

Baseline emissions are quantified by assuming the same routes, vehicles, fuel, and driving behavior as the project, and modifying GHG emissions associated with fuel consumption to take account of increased weight transported.

Relevant GHG sources not included in the project boundary (ie, production of raw materials and pallet manufacturing) are considered as leakage.

Additionality	Project Method
Crediting Baseline	Project Method

3 DEFINITIONS

Captive Fleet: A collection of vehicles with clearly defined boundaries, typically owned or managed by one party.

Conventional pallet: A pallet composed mainly of either wood or plastic. Currently, wood pallets dominate the market, representing 90-95% of all pallets produced across the globe.[3]

Freight: Goods transported by commercial fleets.

Lightweight pallet: A pallet that is lighter in weight than its conventional alternative.

Pallet: A flat, portable structure that supports goods during handling, transport and storage.

Trip: A journey where the weight transported remains constant. A new trip begins each time there is a change in the transported weight.

4 APPLICABILITY CONDITIONS

This methodology applies to project activities that reduce GHG emissions from the transportation of freight on truck fleets by reducing the weight of pallets transported, hence reducing fuel consumption. Emission reductions claimed under this methodology are only related to increased fuel efficiency due to the use of lightweight pallets.

[3] FP Innovations: PalletTrends 2009. http://www.valuetowood.ca/imports/pdf/en/market_profiles/2009/Palette-Trends2009.pdf

The following conditions apply to this methodology:

Pallet Performance Requirements

a) Lightweight pallets deployed in the project must offer the same or better technical performance compared to the baseline pallets. This must be demonstrated via certified conformance with ISO 8611-2.

Pallet Identification

a) Lightweight pallets deployed in the project must each have a unique ID (e.g., Radio-Frequency Identification (RFID) tags, Universal Product Code (UPC), etc.) to facilitate monitoring.

Fleet, Truck and Fuel Characteristics

a) Vehicles are part of a captive fleet.
b) If project proponent is not the captive fleet operator, a contract addressing ownership of emission reduction credits with the captive fleet operator is required.
c) When freight is transported, the freight must be transported on pallets in both the project and baseline scenarios.
d) If biofuel blends are used, the blending ratio in the project and baseline must be the same.

If any of these conditions are violated during a single trip, the trip must not be included in the project and no emission reduction credits can be claimed from the trip.

This methodology is not applicable to emission reductions from the following scenarios:

a) Introduction of low-emission vehicles (eg, compressed natural gas vehicles, electric vehicles, liquid petroleum gas vehicles, and hybrid vehicles with electrical and internal combustion motive systems);
b) Fuel switch in existing vehicles (eg, fossil fuel to plant oil use);
c) Retrofitting of existing vehicles (eg, switching from high greenhouse gas intensive to low greenhouse gas intensive fossil fuel);
d) Modal shift in transportation; and
e) Changes in truck freight capacity enabled by use of lightweight pallets.

5 PROJECT BOUNDARY

The project boundary encompasses truck fleets while carrying lightweight pallets as part of their cargo and consuming fossil fuel.

Emission sources are summarized in Table 1 below.

Source		Gas	Included?	Justification/Explanation
Baseline	Vehicles consuming fossil fuel	CO_2	Yes	Main emission source in the combustion of fossil fuel.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
Project	Vehicles consuming fossil fuel	CO_2	Yes	Main emission source in the combustion of fossil fuel.
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.

Project and baseline emissions from loading and unloading of trucks are excluded because they would not be significant.

Return trips (i.e., empty pallets only) can be included as a trip as part of the “Vehicles consuming fossil fuel” source if all requirements, including monitoring requirements, are met.

For simplification and conservativeness, production of raw materials used to manufacture conventional pallets and manufacturing of conventional pallets are not included in the baseline boundary.

Production of raw materials used to manufacture lightweight pallets and manufacturing of lightweight pallets are not included in the project boundary, but are included under leakage.

6 PROCEDURE FOR DETERMINING THE BASELINE SCENARIO

Project participants must use the most recent version of the CDM's *Combined tool to identify the baseline scenario and demonstrate additionality* to identify alternative baseline scenarios and determine the most plausible scenario.

The following must be adhered to when applying each of the steps in the CDM tool:

Step 1: Identify all realistic and credible alternatives to using lightweight pallets

When applying Sub-step 1a of the tool, alternative scenarios for pallet types must include all realistic and credible alternatives to the project activity that are available in the relevant market.

The following likely scenarios for pallet types must be assessed, *inter alia*:

- Wood pallets, and
- Petroleum-based plastic pallets.

All considered scenarios must provide the same type and level of service, ie, they must be able to transport the same amount of freight as transported under the project activity.

Step 2: Barrier Analysis

Barrier analysis must be used to assess which of these alternatives is to be excluded from further consideration (i.e. alternatives where barriers are prohibitive or which are clearly economically unattractive) and Step 3 must be applied for all remaining alternatives.

Step 3: Investment Analysis

In applying Step 3, the following must be followed:

- The investment analysis must be carried out from the perspective of the project participants, i.e. the owner or operator of the truck fleet.
- At a minimum, project participants must take into account the following costs in the investment analysis:
    a. Costs of acquiring and maintaining pallets
    b. Fuel costs
    c. Costs of disposing of pallets at the end of their useful life

7 PROCEDURE FOR DEMONSTRATING ADDITIONALITY

Project participants must use the most recent version of the CDM's "Combined tool to identify the baseline scenario and demonstrate additionality" to demonstrate additionality. The additional procedures described above in Section 6 must be used when applying this tool.

8 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

8.1 Baseline Emissions

The first step to determine the baseline emissions is to calculate the fleet's project emission factor per tonne of freight carried 1 kilometer. The project emission factor is determined by dividing total fleet-wide, fuel consumption-related emissions for eligible trips during the project by the sum of freight weight and distance travelled for each vehicle and trip in the fleet. The weight transported must stay constant during each trip. Each time the weight changes, a trip must be declared and the project proponent monitors the weight of freight, distance travelled, and number of pallets for each trip. Only trips where there is complete substitution of the baseline pallets must be quantified using the following equations (i.e., no partial substitution at the trip level is allowed).

$$PEF_y = \sum_{j,k,y}\left(FC_{j,k,y} \times EF_{j,y}\right) \div \sum_{i,k,y}\left(W_{i,k,y} \times D_{i,k,y}\right) \quad (1)$$

Where:

PEF_y Project emission factor in year y per weight-distance of freight (t CO_2/t km)
$FC_{j,k,y}$ Quantity of fuel type j combusted by the fleet for eligible trips k in year y (volume of fuel)
$EF_{j,y}$ GHG emission factor of fuel j in year y (t CO_2/unit volume of fuel consumed)
$W_{i,k,y}$ Weight of freight (including project pallets) transported by vehicle i for trip k in year y (metric tonnes)
$D_{i,k,y}$ Distance travelled by vehicle i for trip k in year y (km)

The total baseline emissions are then calculated using the project emission factor applied to the same fleet and distance travelled, assuming increased freight weight transported due to use of conventional pallets.

$$BE_y = PEF_y \times \sum_{i,k,y}\left(D_{i,k,y} \times \left(W_{i,k,y} + \left(P_B - P_P\right) \times N_{i,k,y}\right)\right) \quad (2)$$

Where:

BE_y Total baseline emissions in year y (t CO_2/year)
PEF_y Project emission factor in year y per weight-distance of freight (t CO_2/t km)
$D_{i,k,y}$ Distance travelled by vehicle i for trip k in year y (km)
$W_{i,k,y}$ Weight of freight (including project pallets) transported by vehicle i for trip k in year y (metric tonnes)
P_B Weight of each baseline pallet (metric tonnes)
P_P Weight of each project pallet (metric tonnes)
$N_{i,k,y}$ Number of pallets carried by vehicle i for trip k in year y

8.1.1 Baseline Emissions (Alternative Approach)

This alternative approach can only be used if the data for the approach described in 8.1 is not available and must be used with the approach described in section 8.2.1. The approaches described in sections

8.1 and 8.2 are more accurate and preferred. If the data to determine the baseline emissions using the approach described in 8.1 is not available (eg, no fuel consumption or freight weight data), the following alternative approach using default emission factors from recognized sources is acceptable.

$$BE_y = DEF_{j,y} \times \sum_{i,k,y}\left(D_{i,k,y} \times \left(W_{i,k,y} + \left(P_B - P_P\right) \times N_{i,k,y}\right)\right) \quad (3)$$

Where:

BE_y Total baseline emissions in year y (t CO_2/year)
$DEF_{j,y}$ Default emission factor for fuel type j in year y per weight-distance of freight (t CO_2/t km)
$D_{i,k,y}$ Distance travelled by vehicle i for trip k in year y (km)
$W_{i,k,y}$ Weight of freight (including project pallets) transported by vehicle i for trip k in year y (metric tonnes)
P_B Weight of each baseline pallet (metric tonnes)
P_P Weight of each project pallet (metric tonnes)
$N_{i,k,y}$ Number of pallets carried by vehicle i for trip k in year y

8.2 Project Emissions

Project emissions are determined by monitoring the consumption of fuel for eligible trips (as defined above in section 8.1) for the entire fleet transporting freight using lightweight pallets, according to the following formula:

$$PE_y = \sum_{j,y}\left(FC_{j,k,y} \times EF_{j,y}\right) \quad (4)$$

Where:

PE_y Total project emissions in year y (t CO_2/year)
$FC_{j,k,y}$ Quantity of fuel type j combusted by the fleet for eligible trips k in year y (volume of fuel)
$EF_{j,y}$ GHG emission factor of fuel j in year y (t CO_2/unit volume of fuel consumed)

8.2.1 Project Emissions (Alternative Approach)

This alternative approach can only be used if the data for the approach described in 8.2 is not available and must be used with the approach described in section 8.1.1. The approaches described in sections 8.2 and 8.1 are more accurate and preferred. If the data to determine the project emissions using the approach described in 8.2 is not available (ie, no fuel consumption data), the following alternative approach using default emission factors from recognized sources is acceptable.

$$PE_y = DEF_{j,y} \times \sum_{i,k,y}(D_{i,k,y} \times W_{i,k,y}) \quad (5)$$

Where:

PE_y Total project emissions in year y (t CO_2/year)
$DEF_{j,y}$ Default emission factor for fuel type j in year y per weight-distance of freight (t CO_2/t km)
$D_{i,k,y}$ Distance travelled by vehicle i for trip k in year y (km)
$W_{i,k,y}$ Weight of freight (including project pallets) transported by vehicle i for trip k in year y (metric tonnes)

Note that using this alternative approach allows emission reductions to be calculated using a default emission factor, distance travelled, weight reduction per pallet, and the number of pallets carried. The total weight transported is the same in equations (3) and (5), and cancels out when project emissions are subtracted from baseline emissions. Baseline and project emissions can be quantified separately by using actual weight of freight transported data (if available), or by making reasonable assumptions about the weight of freight transported and justifying those assumptions. Any uncertainty in these assumptions will be eliminated when project emissions are subtracted from baseline emissions to quantify emission reductions.

8.3 Leakage

This methodology estimates the following sources of leakage:

- Production of raw materials used to manufacture lightweight pallets; and
- Manufacturing of lightweight pallets.

Positive leakage from baseline sources (e.g., production of raw materials used to manufacture conventional pallets, manufacturing of conventional pallets) is not included, which is conservative. Leakage associated with transportation of raw materials used to manufacture pallets, transportation of manufactured pallets (before first use) and end of life treatment for pallets is considered insignificant and is not included.

Leakage is calculated as follows:

$$LE_y = LE_{RM,y} + LE_{M,y} \quad (6)$$

Where:

LE_y Leakage emissions in year y (t CO_2)
$LE_{RM,y}$ Leakage emissions associated with production of raw materials used to manufacture lightweight pallets in year y (t CO_2)
$LE_{M,y}$ Leakage emissions associated with manufacturing of lightweight pallets

8.3.1 Production of raw materials used to manufacture lightweight pallets

Emissions from production of raw materials used to manufacture lightweight pallets are estimated by listing all raw materials that account for a total of at least 95% of the lightweight pallet mass, then estimating the upstream emissions for their production, as follows:

$$LE_{RM,y} = \Sigma_x (N \times M_x \times EF_x) \quad (7)$$

Where:

$LE_{RM,y}$	Leakage emissions associated with production of raw materials used to manufacture lightweight pallets in year y (t CO_2)
N	Number of pallets consumed per year
M_x	Mass of raw material x consumed per pallet manufactured (tonnes)
EF_x	Upstream emission factor for production of raw material x (t CO_2/t raw material x)

8.3.2 Manufacturing of lightweight pallets

Emissions from manufacturing of lightweight pallets are estimated by listing all GHG sources from manufacturing lightweight pallets, then estimating manufacturing emissions as follows:

$$LE_{M,y} = \Sigma_a (N \times A_a \times EF_a) \quad (8)$$

Where:

$LE_{M,y}$	Leakage emissions associated with manufacturing of lightweight pallets in year y (t CO_2)
N	Number of pallets consumed per year
A_a	Activity level from GHG source a per pallet manufactured (energy consumption or fuel volume units)
EF_a	Emission factor for GHG source a (t CO_2 /unit energy consumption or fuel volume)

If primary energy consumption data from manufacturing lightweight pallets is not available, the project proponent may use other primary or secondary data sources to estimate emissions from manufacturing of lightweight pallets. These sources of data must be justified (ie, alternative sources of data must be listed and the reasons for selecting the data used must be given) using criteria that include data source (recognized and authoritative sources are preferred); geographic, temporal and technology specificity; conservativeness (ie, does not overestimate emission reduction); and if the data is peer reviewed (preferred).

8.4 Summary of GHG Emission Reduction and/or Removals

Emission reductions are calculated as follows:

$$ER_y = BE_y - PE_y - LE_y \quad (9)$$

Where:

ER_Y Net GHG emissions reductions in year y
BE_Y Baseline emissions in year y
PE_y Project emissions in year y
LE_y Leakage in year y

9 MONITORING

9.1 Data and Parameters Available at Validation

Data Unit / Parameter:	P_B
Data unit:	Weight unit (e.g. metric tonnes)
Description:	Weight of each individual baseline pallet
Source of data:	Measurements using weight scales Manufacturer specifications
Justification of choice of data or description of measurement methods and procedures applied:	Obtain the weight of one baseline pallet by consulting with the specifications provided by the manufacturer. Cross check using properly calibrated weight scales and a statistically significant sample of baseline pallets.
Any comment:	-

Data Unit / Parameter:	$DEF_{j,y}$
Data unit:	t CO_2/t km
Description:	Default GHG emission factor for fuel type j per unit weight-distance of freight in year y
Source of data:	Statistics published by recognized sources such as US government or industry associations. For example, EPA Climate Leaders publication "Optional Emissions from Commuting, Business Travel & Product Transport, EPA43-R-08-006" or WRI/WBCSD GHG Protocol Mobile Combustion tool
Justification of choice of data or description of measurement methods and procedures applied:	The range of appropriate data must be documented and the chosen data must be justified, using criteria that include data source (recognized and authoritative sources); geographic, temporal and technology specificity; conservativeness (i.e., does not overestimate emission reduction); and if the data is peer reviewed (preferred).
Any comment:	The above justification is required to manage the uncertainty associated with this parameter.

9.2 Data and Parameters Monitored

Data Unit / Parameter:	$FC_{j,y}$
Data unit:	Volume units per year (e.g. gallons/year)
Description:	Quantity of fuel type *j* combusted by the fleet during the year *y*
Source of data:	Onsite and offsite sources a) Purchasing records b) Metering c) Logs
Description of measurement methods and procedures to be applied:	Purchasing records • For centralized purchases, use invoices from suppliers and adjust for inventory of fuel at beginning and end of year • For offsite purchases, use electronic records from cardlock or similar system Metering • Use fuel flow meters to measure volume of fuel transferred to vehicles at central facilities or offsite filling stations Logs • Record volume of fuel consumed per vehicle per refill in electronic or manual logs
Frequency of monitoring/recording:	Continuously
QA/QC procedures to be applied:	Purchasing records must be cross checked against metered fuel transferred to vehicles. Fuel flow meters must be calibrated according to current good practice (e.g., relevant industry standards). The consistency of metered fuel consumption quantities must be cross-checked by an annual reconciliation based on purchased quantities and stock changes. Metered fuel consumption quantities must also be cross-checked with available purchase invoices from financial records (e.g., cardlock system)
Any comment:	-

Data Unit / Parameter:	$EF_{j,y}$
Data unit:	t CO_2/unit volume of fuel consumed

<table>
<tr><td>Description:</td><td>GHG emission factor of fuel type j consumed by the fleet in year y</td></tr>
<tr><td>Source of data:</td><td>The following data sources may be used if the relevant conditions apply:

<table><tr><th>Data source</th><th>Conditions for using data source</th></tr><tr><td>a) Regional or national default values from recognized sources</td><td>These values must be based on well-documented, reliable sources (e.g., national energy balances, government publications, industry associations, WRI/WBCSD GHG Protocol)</td></tr><tr><td>b) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If a) is not available</td></tr></table></td></tr>
<tr><td>Description of measurement methods and procedures to be applied:</td><td>If more than one recognized source is available, the most appropriate source must be selected, based on data quality indicators including technological appropriateness, regional specificity, and vintage of the data.</td></tr>
<tr><td>Frequency of monitoring/recording:</td><td>Review appropriateness of the values annually</td></tr>
<tr><td>QA/QC procedures to be applied:</td><td>Fuel type j must be recorded for each refill, transfer or other transaction, including the fraction of biofuel present (if applicable).</td></tr>
<tr><td>Any comment:</td><td>-</td></tr>
</table>

Data Unit / Parameter:	$W_{i,k,y}$
Data unit:	Weight unit (e.g. metric tonnes)

Description:	Weight of freight (including pallets) transported by vehicle *i* for trip *k* in year *y*
Source of data:	Onsite measurements by project participants, or Shipping records
Description of measurement methods and procedures to be applied:	The weight of freight transported under the VCS project by the project vehicles must be measured at the point of origin using weight scales. The amount must be cross-checked with the freight received at destination. If direct weight measurement is not feasible, shipping records must be used to estimate weight of freight transported.
Frequency of monitoring/recording:	Continuously
QA/QC procedures to be applied:	Weight scales must be calibrated according to current good practice (e.g., relevant industry standards). If measurements used, cross check measurements against shipping records. If shipping records used, cross check shipping records against billing or other information systems.
Any comment:	-

Data Unit / Parameter:	$D_{i,k,y}$
Data unit:	Distance unit (e.g. kilometers)
Description:	Total distance travelled by vehicle *i* for trip *k* in year *y* (kilometers)
Source of data:	a) Odometer readings; b) Tracking solution; and/or c) Electronic Data Interchange (EDI) / Advanced Shipping Notice (ASN) system
Description of measurement methods and procedures to be applied:	For a): Monitor odometer readings of all trucks in fleet at beginning and end of each trip. For b): Use a tracking solution (e.g. GPS vehicle tracking) to monitor routes and distances travelled by each vehicle. For c): Use transactional data from the fleet operator's EDI/ASN system, in conjunction with a tracking software solution to provide an audit trail of where the vehicles have travelled.
Frequency of monitoring/recording:	Continuously
QA/QC procedures to be applied:	Check consistency of distance records provided by the fleet operator by comparing recorded distances from odometer readings or tracking solution with information from other sources (e.g. driver logs and/or route maps).

Any comment:	-

Data Unit / Parameter:	P_P
Data unit:	Weight unit (e.g. metric tonnes)
Description:	Weight of each individual project pallet
Source of data:	Measurements using weight scales Manufacturer specifications
Description of measurement methods and procedures to be applied:	Obtain the weight of one project pallet by consulting with the specifications provided by the manufacturer.
Frequency of monitoring/recording:	Annually or more frequently if pallet specifications change.
QA/QC procedures to be applied:	Cross check using properly calibrated weight scales and a statistically significant sample of project pallets
Any comment:	-

Data Unit / Parameter:	$N_{i,k,y}$
Data unit:	Number
Description:	Number of pallets carried by vehicle *i* for trip *k*
Source of data:	Shipping records Unique ID for each pallet (e.g., Radio-Frequency Identification (RFID) tags, Universal Product Code (UPC), etc.)
Description of measurement methods and procedures to be applied:	EDI/ASN information system to make use of unique ID for each pallet so that the number of pallets carried by each vehicle for each trip is recorded automatically.
Frequency of monitoring/recording:	Continuously
QA/QC procedures to be applied:	Project participants must cross-check the total number of pallets recorded by the EDI/ASN information system with onsite shipping records. Cross check the average weight carried per pallet against pallet capacity for reasonableness and potential inconsistencies.
Any comment:	-

Leakage Data and Parameters

Data Unit / Parameter:	N
Data unit:	–
Description:	Number of pallets consumed by fleet operator per year
Source of data:	Average number of pallets in use and average lifetime of pallets
Description of measurement methods and procedures to be applied:	The number of pallets consumed per year is determined by monitoring the average number of pallets used by the fleet operator each year (e.g., average of beginning and ending inventory, or average of 12 monthly inventories), and dividing it by the average lifetime of each pallet. Average lifetime (i.e. number of years the average pallet lasts before its final disposal) is determined from internal records, manufacturer specifications and/or industry standard testing procedures.
Frequency of monitoring/recording:	Annually
QA/QC procedures to be applied:	Cross check against purchasing records for reasonableness. Note that annual purchases will vary depending on a number of factors, but will, over time, converge to the overall number of pallets consumed. The average lifetime from manufacturer specification or industry standards must be compared against internal records to account for project specific conditions.
Any comment:	-

Data Unit / Parameter:	M_x
Data unit:	Weight unit (e.g. metric tonnes)
Description:	Mass of raw material x consumed per pallet manufactured
Source of data:	Manufacturer specifications
Description of measurement methods and procedures to be applied:	The mass of each type of raw material consumed per pallet must be determined from manufacturer specifications and include the mass of raw material consumed as waste in the process.
Frequency of monitoring/recording:	Annually or more frequently if pallet specifications change

QA/QC procedures to be applied:	Cross check manufacturer specification against current version of pallet to ensure current pallet specifications are being used. Cross check against total weight of pallet to ensure at least 95% of the total pallet weight is accounted for.
Any comment:	-

Data Unit / Parameter:	EF_x
Data unit:	t CO_2 / t of raw material x
Description:	Upstream emission factor for production of raw materials for pallets
Source of data:	The following data sources may be used: a) Primary data from suppliers b) Industry data c) National Life Cycle Inventory (LCI) databases d) Commercial LCI databases
Description of measurement methods and procedures to be applied:	For secondary data, emission factors for each raw material must be determined from recognized sources for each raw material consumed. For raw materials with no secondary data available from a recognized source, proxy data must be used for a similar material that is likely to have a similar upstream emission factor. If more than one recognized source is available, the most appropriate source must be selected, based on data quality indicators including technological appropriateness, regional specificity, and vintage of the data.
Frequency of monitoring/recording:	Annually

QA/QC procedures to be applied:	For primary data from suppliers, request documentation of methodologies used and compare to good practices. Identify and correct any major deficiencies. For secondary data from publications or databases, compare multiple sources if available. The range of appropriate data must be documented and the chosen data must be justified, using criteria that include data source (recognized and authoritative sources are preferred); geographic, temporal and technology specificity; conservativeness (i.e., does not overestimate emission reduction); and if the data is peer reviewed (preferred).
Any comment:	The above justification is required to manage the uncertainty associated with this parameter.

Data Unit / Parameter:	A_a
Data unit:	Energy consumption or fuel volume units
Description:	Activity level from GHG source a per pallet during manufacturing of pallet
Source of data:	Manufacturer's records • Invoices from suppliers • Metered data
Description of measurement methods and procedures to be applied:	The activity level of each GHG emission source per pallet must be determined by monitoring the total amount of each energy consuming activity at the manufacturer's facility per year and dividing by the number of pallets produced by the manufacturer's facility per year. If more than one product is produced at the facility, allocation rules consistent with ISO 14040/44 must be applied.
Frequency of monitoring/recording:	Annually
QA/QC procedures to be applied:	-
Any comment:	-

Data Unit / Parameter:	EF_a
Data unit:	(t CO_2 /unit energy consumption or fuel volume units)
Description:	Emission factor for GHG source a

<table>
<tr><td>Source of data:</td><td>The following data sources may be used:

<table><tr><th>Data source</th><th>Conditions for using data source</th></tr><tr><td>a) Regional or national default values from recognized sources</td><td>This is the preferred source.

These values must be based on well-documented, reliable sources (e.g., national energy balances, government publications, WRI/WBCSD GHG Protocol)</td></tr><tr><td>b) IPCC default values at the upper limit of the uncertainty at a 95% confidence interval as provided in table 1.4 of Chapter 1 of Vol. 2 (Energy) of the 2006 IPCC Guidelines on National GHG Inventories</td><td>If a) is not available.</td></tr></table></td></tr>
<tr><td>Description of measurement methods and procedures to be applied:</td><td>Emission factors for each GHG emission source must be determined from regional, national or international default values for each raw material consumed per pallet.

For a): Review appropriateness of the values annually.
For b): Any future revision of the IPCC Guidelines must be taken into account.</td></tr>
<tr><td>Frequency of monitoring/recording:</td><td>For a): Review appropriateness of the values annually.
For b): Any future revision of the IPCC Guidelines must be taken into account.</td></tr>
<tr><td>QA/QC procedures to be applied:</td><td>-</td></tr>
<tr><td>Any comment:</td><td>-</td></tr>
</table>

9.3 Description of the Monitoring Plan

The project proponent must establish, maintain and apply a monitoring plan and GHG information system that includes criteria and procedures for obtaining, recording, compiling and analyzing data, parameters and other information important for quantifying and reporting GHG emissions relevant for the project and baseline scenario. Monitoring procedures must address the following:

a) Types of data and information to be reported;
b) Units of measurement;
c) Origin of the data;
d) Monitoring methodologies (e.g., estimation, modeling, measurement, calculation);
e) Where options are provided in section 9 above, justification for the option selected;
f) Type of equipment used, if any;
g) Monitoring times and frequencies;
h) QA/QC procedures;
i) Monitoring roles and responsibilities, including experience and training requirements;
j) GHG information management systems, including the location, back up, and retention of stored data.

Where measurement and monitoring equipment is used, the project proponent must ensure the equipment is calibrated according to current good practice (eg, relevant industry standards).

All data collected as part of monitoring must be archived electronically and kept at least for 2 years after the end of the last project crediting period.

QA/QC procedures must include, but are not limited to:

Data Gathering, Input and Handling Measures

- Input data checked for typical errors, including inconsistent physical units, unit conversion errors, typographical errors caused by data transcription from one document to another; and missing data for specific time periods or physical units;
- Input time series data checked for large unexpected variations (eg, orders of magnitude) that could indicate input errors;
- All electronic files to use version control to ensure consistency;
- Physical protection of monitoring equipment (eg, sealed meters and data loggers); and
- Physical protection of records of monitored data (eg, hard copy and electronic records).

Data Documentation

- Input data units checked and documented;
- All sources of data, assumptions and emission factors documented;
- Changes to data, assumptions and emission factors documented; and
- Documented assumptions and algorithms validated based on best practices.

Calculations

- Units for input data and conversion factors documented;
- Units for all intermediate calculations and final results documented;

- Input data and calculated data clearly differentiated;
- Comparison to previous results to identify potential inconsistencies; and
- Results aggregated in various ways to identify potential inconsistencies.

10 REFERENCES AND OTHER INFORMATION

The latest approved versions of CDM tools referenced above are available at:

http://cdm.unfccc.int/Reference/tools/index.html