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Approved VCS Methodology
VMR0005

Version 1.0, 14 November 2014
Sectoral Scope 3

Methodology for Installation of Low-Flow Water Devices

This methodology was developed by Challis Water Controls.

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1 SOURCES

This methodology revision applies to CDM small-scale methodology AMS-II.M, *Demand-side energy efficiency activities for installation of low-flow hot water savings devices*. Project proponents must apply this methodology revision in conjunction with the latest version of AMS-II.M.

This methodology uses as sources:

- The latest version of the CDM *General guidelines for SSC CDM methodologies*
- The latest version of the CDM *Guidelines on the demonstration of additionality of small-scale project activities* (previously known as *Attachment A of Appendix B to simplified modalities and procedures of small scale CDM project activities)*
- The latest version of the CDM S*tandard for sampling and surveys for CDM project activities and programme of activities*
- The Enhanced Capital Allowance (ECA) Scheme for Water – Water Technology Criteria List, (last updated July 2013), Department for Environment, Food and Rural Affairs (DEFRA)

2 SUMMARY DESCRIPTION OF THE METHODOLOGY

Additionality and Crediting Method	
Additionality	Project Method
Crediting Baseline	Project Method

CDM small-scale methodology AMS-II.M applies to project activities that permanently replace baseline water flow devices (eg, showerheads, faucets) with low-flow hot water savings devices in residential buildings. This methodology revision expands the applicability of AMS-II.M to allow projects to occur in non-residential buildings and to include installation of inline devices which do not permanently replace baseline devices.

This revision also provides alternative methods for monitoring parameters and quantifying emission reductions. Specifically, this revision allows for the use of default factors for the estimation of certain parameters as an alternative to direct measurement.

3 DEFINITIONS

In addition to the definitions provided in CDM methodology AMS-II.M, and the definitions set out in VCS document *Program Definitions*, the following definitions apply in this methodology revision:

Baseline Device
In the baseline scenario, the device that is connected to the hosing apparatus where water enters through the back of the device and exits through the front of the device (eg, the showerhead installed in the baseline scenario)

Equivalent Level of Service
A service level that provides the same functional comfort and cleaning performance under the baseline and project scenarios

Industrial Building
A building used for industrial purposes (eg, factory-office multiuse buildings, factory-warehouse multiuse buildings, heavy manufacturing buildings, industrial parks buildings, light manufacturing buildings, and research and development park buildings)

Inline Device
A low-flow hot water savings device that is installed within the baseline device

Low-Flow Device
Water flow devices (eg, showerheads, facets), and devices installed within water flow devices (eg, inline devices, non-removable flow restrictors), which are designed to reduce the flow of water

Non-Residential Building
A building where less than half of the gross floor area is used for dwelling purposes (eg, commercial, educational and health buildings)

Residential Building
A building where half or more of the gross floor area is used for dwelling purposes (eg, single family homes, apartments, hotels, etc.)

4 APPLICABILITY CONDITIONS

Projects must comply with all applicability conditions set out in CDM methodology AMS-II.M, noting that paragraphs 2, 3, 7 and 8 (as specified in AMS-II.M version 2.0, issued 4 October 2013, the version of the methodology current on the issuance date of this methodology revision) must be read as follows:

Paragraph 2

This methodology comprises activities for direct installation of low-flow hot water savings devices that are used in residential buildings and non-residential buildings, but not industrial buildings. These devices may include low-flow devices used for personal bathing (ie, low-flow showerheads), kitchen faucets and/or bathroom faucets (hereafter collectively referred to as *low-flow devices*).

Paragraph 3

Low-flow devices may contain removable inline devices or non-removable flow restrictions. Such devices must be as difficult to install and uninstall as baseline devices themselves, and must be an integral part of the water flow system.

Paragraph 7

The project proponent must ensure that the low-flow devices:

a) Qualify as a water saving device through reference to applicable standards. This revision adds the Enhanced Capital Allowance (ECA) scheme for water in the UK as an applicable standard for certain devices to Appendix 1 of AMS-II.M.

b) Provide an equivalent level of service to baseline devices. With respect to inline devices, since the inherent nature of such devices is to reduce the flow of water through the baseline device, they must have the capability to compensate for the reduction in flow by the introduction of a technology or effect that allows the user to perceive at least the same level of service after the installation of the device, resulting in a shower of equivalent duration in the baseline and project scenarios.

c) Are used to control the flow of heated water

d) Are determined to be functional at the time of installation

e) Are marked for clear and unique identification for the project activity

Paragraph 8

All projects must explain the proposed method of installation of low-flow devices. In the case of the permanent replacement of a baseline device (as opposed to installation of an in-line device) the project description must also explain the method for collection, destruction and/or recycling of baseline devices. For example, the project proponent may collect the baseline devices, store them in a centralized or decentralized location, destroy them using a third-party recycling facility, and receive certificates of disposal for all salvaged and scrap materials. Where destruction of baseline devices is properly documented, destruction may precede verification.

5 PROJECT BOUNDARY

The project boundary must be determined following the procedure provided in CDM methodology AMS-II.M.

6 BASELINE SCENARIO

The baseline scenario must be determined following the procedure provided in CDM methodology AMS-II.M.

7 ADDITIONALITY

Additionality must be demonstrated following the procedure provided in CDM methodology AMS-II.M.

8 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

AMS-II.M does not account for baseline and project emissions separately, but instead quantifies emission reductions as a function of the reduction in the amount of water that requires heating. This revision follows the same convention.

Where project proponents select the option to use default factors for the relevant parameters set out in Section 9.1 below, equations 1, 3 and 4 as specified in AMS-II.M version 2.0, issued 4 October 2013 (the version of the methodology current on the issuance date of this methodology revision) must be read as follows:

$$ES_y = \Delta W_y * \Delta T * C_p * 2.78 \times 10^{-7} \frac{MWh}{kJ} \quad \textbf{(1)}$$

$$\Delta W_y = (W_{BL,\,calculated} - W_{P,\,calculated}) * 365 \quad \textbf{(3a)}$$

$$W_{p,\,calculated} = FR_{p,\,measured} * D_{calculated} \quad \textbf{(3b)}$$

$$W_{BL,calculated} = FR_{BL,measured} * \frac{W_{p,calculated}}{FR_{P,measured}} \quad \textbf{(4)}$$

Where:

Y	Each year of the project crediting period
ES_y	Energy savings in year y (MWh/yr)
ΔW_y	Difference between annual heated water flow through low-flow device and baseline device (litres/year)
ΔT	Annual average difference in water temperature between water entering the water heating unit used to heat water and the water exiting the low-flow device (^oC)
C_p	Specific heat of water in (^oC) (4.186 kJ/litre)

$W_{BL,calculated}$	Calculated amount of heated water that would flow through the baseline device in one day (litres/day)
$W_{P,calculated}$	Calculated amount of heated water that flows through the low-flow device in one day (litres/day)
$FR_{BL,measured}$	The flow rate of baseline device (litres/minute)
$FR_{P,measured}$	The flow rate of low-flow device (litres/minute)
$D_{calculated}$	Duration of device use per day (minutes/day)

8.1 Leakage

Leakage is not considered an issue for this methodology, and at the time of this writing AMS-II.M does not include procedures for leakage. However, where procedures for addressing leakage are added in a subsequent version of AMS-II.M, such procedures must be followed.

8.2 Net GHG Emission Reductions and Removals

GHG emission reductions must be calculated using the equations in AMS-II.M (given as equations (5) and/or (6) in version 2.0, issued 4 October 2013, the version of the methodology current on the issuance date of this methodology revision).

9 MONITORING

Project proponents must follow the monitoring procedures provided in CDM methodology AMS-II.M, noting the revisions set out in Sections 9.1, 9.2 and 9.3 below.

9.1 Data and Parameters Available at Validation

In addition to the data and parameters set out in AMS-II.M that must be available at validation, the following data and parameters must be available where project proponents select the option to apply default factors for the relevant parameters listed in this section.

Data Unit / Parameter	$FR_{BL,measured}$
Data unit	litres/minute
Description	Flow rate of baseline device

Source of data	Use of a default factor supported by reputable and geographically- and temporally-relevant published reference(s). Where multiple studies are available, the most conservative data must be applied.
Justification of choice of data or description of measurement methods and procedures applied	The project proponent must choose the values in a conservative manner and justify their choice.
Comments	Selected default factors must meet the criteria for default factors set out in the *VCS Standard*. Default factors must be obtained from geographically-relevant documents (eg, studies, codes and/or reports) that have been published by reputable third parties. Project proponents must demonstrate that the geographically-relevant document provides high quality data that can adequately be relied upon (eg, a government commissioned study of the average flow rate of showerheads in a given area).

Data Unit / Parameter	$FR_{P,measured}$
Data unit	litres/minute
Description	Flow rate of project device
Source of data	Measurements taken at the time of project installation or in a representative laboratory setting.
Justification of choice of data or description of measurement methods and procedures applied	Flow rate can be measured directly from the flow device.
Comments	

Data Unit / Parameter	$T_{out,measured}$
Data unit	^{o}C
Description	Annual average temperature of water exiting low-flow device

Source of data	Use of a default factor supported by reputable and geographically- and temporally-relevant published reference(s). Where multiple studies are available, the most conservative data must be applied.
Justification of choice of data or description of measurement methods and procedures applied	The project proponent must choose the values in a conservative manner and justify their choice.
Comments	Maximum allowable temperature is 40^{o}C. Selected default factors must meet the criteria for default factors set out in the *VCS Standard*. Default factors must be obtained from geographically-relevant documents (eg, studies, codes and/or reports) that have been published by reputable third parties. Project proponents must demonstrate that the geographically-relevant document provides high quality data that can adequately be relied upon.

Data Unit / Parameter	$T_{in,measured}$
Data unit	^{o}C
Description	Annual average temperature of water entering water heating device
Source of data	Use of a default factor supported by reputable and geographically- and temporally-relevant published reference(s). Where multiple studies are available, the most conservative data must be applied.
Justification of choice of data or description of measurement methods and procedures applied	The project proponent must choose the values in a conservative manner and justify their choice.

Comments	Selected default factors must meet the criteria for default factors set out in the *VCS Standard*. Default factors must be obtained from locally sourced documents (eg, studies, codes and/or reports) that have been published by reputable third parties. Project proponents must demonstrate that the geographically-relevant document provides high quality data that can adequately be relied upon.

Data Unit / Parameter	$D_{calculated}$
Data unit	Minutes/day
Description	Duration of device use per day
Source of data	Use of a default factor supported by reputable and geographically- and temporally-relevant published reference(s). Where multiple studies are available, the most conservative data must be applied.
Justification of choice of data or description of measurement methods and procedures applied	The project proponent must choose the values in a conservative manner and justify their choice.
Any comment	Selected default factors must meet the criteria for default factors set out in the *VCS Standard*. Default factors must be obtained from geographically-relevant documents (eg, studies, codes and/or reports) that have been published by reputable third parties. Project proponents must demonstrate that the geographically-relevant document provides high quality data that can adequately be relied upon.

9.2 Data and Parameters Monitored

Data / Parameter:	N_y

Description:	Number of low-flow devices installed and operating in year *y*. Ny is the number of project low- flow devices, of each type, documented to have been installed in the year of project implementation multiplied by the percentage of project low-flow devices found to be installed and operating in year y.
Source of data:	Calculated
Description of measurement methods and procedures applied:	See Section 9.3
Frequency of monitoring/recording:	Annual
QA/QC procedures to be applied:	See Section 9.3
Calculation method:	The installed low-flow devices must be sampled to determine how many remain operational. The specific devices to be sampled must be identified and recorded each year prior to actually sampling the devices (see Section 9.3). A record must be kept of the number of devices sampled that are still in operation.

9.3 Description of the Monitoring Plan

Given that the quantification of emission reductions is dependent on the number of low-flow devices installed and continuously operating, it is important to monitor these components of the project. For this methodology, the installation and continued operation of low-flow devices must be tracked by using either a *survey method* or *physical inspection method*. The project description must identify and describe the method selected by the project proponent. The following sections outline the procedures for each method.

9.3.1 Survey Method

In lieu of physical confirmation of initial installation and continued operation of low-flow devices, a survey may be conducted for a sample of devices.

9.3.1.1 Confirmation of Initial Installation

A written attestation by the site owner or operator is required to confirm initial installation of low-flow devices. The attestations must include legally binding liability language, the locations of devices, the number of installed devices, the unique identifier for each device, the date of installation, the appropriate contact at the project site and any other relevant information. The

signed originals must be received by the project proponent, failing which the site must not be included in the project.

9.3.1.2 Confirmation of Continuous Operation

In any given year, emission reductions can only be claimed for devices that are demonstrated to be in place and operational. An annual survey must be conducted for sites included in the project to determine the number of low-flow devices that remain installed and in operation (ie, the initial installation occurs in year 1, and the annual surveys must be conducted in years 2, 3, 4, 5 and onward). The number of questionnaires sent must be selected such that a 90% confidence level and a 10% margin of error are achieved.

The survey must obtain, at minimum, the following:

- Whether and how many low-flow devices have been installed correctly
- Whether and how many low-flow devices are still operational
- A written attestation of continued operation by the site owner or operator. Such attestations must include legally binding liability language, the locations of devices, the number of operating devices, the unique identifier for each device, the date on which each device was confirmed as remaining operational, the appropriate contact at the project site and any other relevant information. The signed originals must be received by the project proponent, failing which the site may not be included in the project.

A statistically valid sample of the locations where low-flow devices have been installed must be used to determine the percentage of devices in continuous operation. The selection of devices to be surveyed must be determined and recorded prior to surveying the devices. Each of these devices must be surveyed and a record must be kept of the number of devices that are still in operation and those that are no longer in operation. The resulting percentage of devices still in operation will be used to determine N_y for each type of low-flow device (eg, showerhead, bathroom faucet and kitchen faucets).

The following must be considered for the survey:

- Surveys must be conducted consistent with the CDM *Standard For Sampling And Surveys For CDM Project Activities And Programme Of Activities*
- The sample must be selected at random
- Surveys are only permitted if the total population is 100 low-flow devices or more. This requirement is included to ensure a normal population and a statistically valid sample size can be achieved. Where the total population is less than 100 instances, all instances must be surveyed.

9.3.1.3 Survey Questionnaire Distribution and Response Tabulation

The project proponent must choose the method of questionnaire distribution (eg, mail, email or phone) and collection. All distributed questionnaires are counted as part of the response tabulation. If a response is not received for a questionnaire, it must be assumed that the device is no longer in use. Therefore, the project proponent should use any method at its disposal to ensure that each questionnaire is responded to.

The following example illustrates the use of a survey. A project proponent has 10,000 installed devices located at various hotels and individual residences. Initial confirmation of installation has been attested to in year 1, and in year 2 the project proponent begins the survey process to confirm continuous operation. The confidence level calculation determines that 100 installed devices must be surveyed. The project proponent chooses to send out a postcard and an email to the operators of at least 100 of the units, being sure to choose a random sample of operators. In this case, the questionnaire is sent to two hotels with 100 units per hotel, and 50 residential locations with two units per residence.

Responses are received from one hotel and 20 of the residential locations and the responses show a 90% retention/operation rate. The project proponent then chooses to call the hotel and 30 residential locations until a representative at the location can be reached and provide a response to the survey. The project proponent is able to reach the other hotel and 5 of the remaining residential locations, which reveals a 60% retention/operation rate. The remaining 25 residential locations do not provide a response and, therefore, the project proponent must assume a 0% retention/operation rate for those devices. The total retention/operation rate on the survey is calculated as (140 x 0.90) + (110 x 0.60) + (50 x 0) = 192 of the 300 surveyed units are still operational. Therefore, a 64% retention rate is assumed for the entire project population of 10,000 installed devices, or 6,400 devices.

9.3.2 Physical Inspection Method

The project proponent may alternatively choose to confirm initial installation and continuous operation of low-flow devices by physically inspecting a sample of devices on site.

9.3.2.1 Confirmation of Initial Installation

The project proponent is responsible for physically visiting the project sites and determining the number of devices that have been installed. The project proponent must maintain accurate records of the dates and locations of installation, the number of devices installed, the unique identifier for each device, the appropriate contact at the project site and any other relevant information.

9.3.2.2 Confirmation of Continuous Operation

In any given year, emission reductions can only be claimed for devices that are demonstrated to be in place and operational. Inspections must be conducted for sites included in the project to determine the number of low-flow devices that remain installed and in operation. Inspections must be undertaken on an annual basis (ie, the initial installation occurs in year 1, and the inspection must be conducted in years 2, 3, 4, 5 and onward). Inspections must be undertaken such that a 90% confidence level and a 10% margin of error are achieved.

The inspection must establish, at minimum, the following:

- Whether and how many low-flow devices have been installed correctly
- Whether and how many low-flow devices are still operational

A statistically valid sample of the locations where low-flow devices have been installed must be used to determine the percentage of devices in continuous operation. The selection of devices to be inspected must be determined and recorded prior to inspecting the devices. Each of these devices must be inspected and a record must be kept of the number of devices that are still in operation and those that are no longer in operation. The resulting percentage of devices still in operation will be used to determine Ny for each type of low-flow device (eg, showerhead, bathroom faucet and kitchen faucets).

9.4 Data Management and Data Quality

The project proponent must maintain a database with all relevant project data. At a minimum, project data captured must include documentation of all parameters required by the methodology. The data must be of sufficient quality to fulfill the monitoring requirements of this methodology.

The database must record the following information for each location where low-flow devices are installed:

- Geographic location
- Property type (residential or non-residential)
- Property manager and/or owner contact information
- Unique identifier for each installed unit
- Date(s) of device installation
- All parameters relevant for the specific location, including shower temperature, shower duration, number of showers per household or facility, hot water heating source and hot water heater efficiency
- Any other applicable ongoing monitoring information as required by the monitoring plan

The project proponent must establish and apply quality management procedures to manage data and information. Written procedures must be established for each measurement task outlining responsibility, timing and record location requirements.

Record keeping practices must include:

- Electronic recording of values of logged parameters for each monitoring period
- Offsite electronic back-up of all logged data
- Maintenance of all documents and records in a secure and retrievable manner for at least two years after the end of the project crediting period

Quality assurance/quality control procedures must also be applied to add confidence that all measurements and calculations have been made correctly. These may include, but are not limited to:

- Protecting monitoring equipment (sealed meters and data loggers)
- Protecting records of monitored data (hard copy and electronic storage)
- Checking data integrity on a regular and periodic basis (manual assessment, comparing redundant metered data, and detection of outstanding data/records)
- Comparing current estimates with previous estimates to identify any abnormal readings
- Providing sufficient training to project participants to install and maintain project devices
- Establishing minimum experience and requirements for operators in charge of project and monitoring
- Performing recalculations to make sure no mathematical errors have been made

10 REFERENCES

None

DOCUMENT HISTORY

Version	Date	Comment
v1.0	14 Nov 2014	Initial version