CLEAN DEVELOPMENT MECHANISM

CDM-MP74-EC01-A01

Draft Large-scale Methodology

AM00XX: Energy efficient refrigerators and air-conditioners for households

Version 01.0

Sectoral scope(s): 03

DRAFT

United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. The CDM Executive Board at its 94th meeting (EB 94) considered a draft new methodological tool: TOOL00XX “Determination of standardized baselines for energy efficient refrigerators and air-conditioners”, and requested the Methodologies Panel (MP) and the Small-Scale Working Group (SSC WG) to further work on the draft new tool and develop a draft new methodology that is compatible with the tool. In doing so, the MP and the SSC WG shall address the following issues:

    a) Allow for refrigerator testing requirements with "IEC standard IEC 62552-1:2015 Household refrigerating appliances - Characteristics and test methods";

    b) Include additional guidance on accounting for any minimum efficiency performance standard in the host country;

    c) Include provisions to address autonomous efficiency improvements of appliances and to ensure that the service level of project and baseline equipment are comparable;

    d) Reconsider guidance in the case of replacement baseline on the definition of new baseline when the lifetime of the replaced refrigerator has expired;

    e) Further assess the proposed efficiency thresholds against the CDM modalities and procedures;

    f) Carry out road testing for the air conditioner component in collaboration with relevant organizations that have expressed interest to contribute (i.e. German Agency for International Cooperation (GIZ), and the Gulf Organization for Research & Development (GORD)).

2. The MP 73 and SSC WG 54 jointly agreed to launch the draft methodology for public input. One input was received.

2. Purpose

3. The draft methodology is in response to EB 94 requests mentioned above and it takes the public input into account.

3. Key issues and proposed solutions

4. This document proposes a draft methodology to cover energy-efficient residential/household air-conditioners and refrigerators and aims to address EB 94 request mentioned above. It follows on the work carried out under annex 4 “Information note: Determination of standardized baselines for energy efficient appliances- refrigerators and air conditioner” and Annex 3 “Draft methodological tool: Determination of standardized baselines for energy efficient refrigerators and air-conditioners” and Annex 1 “Draft methodological tool: Calculation for baseline, project and leakage emissions from the use

of refrigerants" of MP 73 meeting report (available at https://cdm.unfccc.int/Panels/meth/index.html). This draft methodology thus should be read in conjunction with these annexes.

4. Impacts

5. Simplified and standardized methods recommended under the draft new methodology is likely to result in positive impacts on CDM project and programme development, as well as reduced costs of the development of standardized baselines in the Refrigeration and Air-Conditioning (RAC) sector.

5. Recommendations to the Board

6. The MP recommends that the Board adopts this final draft methodology in conjunction with draft TOOL00XX: "Determination of standardized baselines for energy efficient refrigerators and air-conditioners" (as contained in Annex 3 to the report of the MP 74 meeting) to be made effective at the time of the Board's approval.

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1. Introduction

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

Table 1. Methodology key elements

Typical project(s)	Installation of new energy-efficient refrigerators and air-conditioners as replacement or new sales projects.
Type of GHG emissions mitigation action	Energy efficiency: Displacement of more-GHG-intensive service by use of more-efficient technology.

2. Scope, applicability, and entry into force

2.1. Scope

2. The methodology provides guidance to estimate emission reductions for project activities that involve the installation of new, energy-efficient refrigerators and air-conditioners (RACs) for residential/household applications as replacement or new sales projects.

3. This methodology credits emission reductions due to the reduction in electricity consumption from use of new and more efficient units. In addition, emission reductions resulting from the use of low Global Warming Potential (GWP) refrigerants[1] is included in the specific case of air-conditioners[2].

2.2. Applicability

4. Project units are Refrigerators and Air-conditioners that use refrigerants and Polyurethane (PUR) foam blowing agents with no ozone depleting potential (ODP) and low GWP (e.g. Refrigerants and blowing agents such as Hydrofluoroolefins or Hydrocarbons with GWPs < 15).

5. The households receiving project units are connected to a national or regional electricity grid.

2.3. Entry into force

6. The date of entry into force is the date of the publication of the EB 96 meeting report on the 22 September 2017.

2.4. Applicability of sectoral scope

7. For validation and verification of CDM projects and programme of activities by a designated operational entity (DoE) using this methodology sectoral scope 03 is mandatory.

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[1] Leakage of refrigerant from refrigerators are not to be considered.

[2] Emission reductions associated with the use of foam blowing agents is not currently covered and project proponents may submit revision requests in accordance with the applicable procedure.

3. Normative references

8. Relevant provisions from the latest approved versions of the following documents shall be applied:

   (a) Draft TOOLXX “Determination of standardized baselines for energy efficient refrigerators and air-conditioners” to determine baseline emissions” (hereafter **RAC Tool**);

   (b) Draft TOOLXX “Calculation of baseline, project and leakage emissions from the use of refrigerants” (hereafter **Refrigerant Tool**);

   (c) “Guidelines for quality assurance and quality control of data used in the establishment of standardized baselines”;

   (d) “Procedure for development, revision, clarification and update of standardized baselines”;

   (e) “Standard for data coverage and validity of standardized baselines”.

9. When tools/standards are used in conjunction with the methodology, all applicability conditions and requirements stated in the referred tools/standards shall also apply.

4. Definitions

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

11. For the purpose of this methodology, the remaining lifetime of the equipment is defined as the time for which the existing equipment can continue to operate before it has to be replaced/discarded for technical reasons, such as safety reasons or deteriorated performance. The remaining lifetime is expressed in years or hours of operation.

5. Baseline methodology

5.1. Project boundary

12. The project boundary is the physical, geographical location of all the project energy efficient RAC equipment and systems together with the inefficient units that they displace.

5.2. Identification of Baseline scenario

13. Under this methodology a benchmark approach is applied using the tool referred above under paragraph 8 (a) to establish the baseline scenario and demonstrate additionality, recognizing that one or several measures for GHG emission reductions may be undertaken within RAC sector.

14. As long as the electricity intensity of new RACs (e.g., kWh/litre/y or kWh/cooling capacity/y) of a particular class and design, introduced by the project activity, is lower than the benchmark established, the emission reductions for this class and design, calculated as per this methodology, are deemed additional. A separate assessment of additionality is therefore not required under this methodology. This approach is in line with the approved “Guidelines for the establishment of the sector specific standardized baselines”.

5.2.1. Identification of the baseline scenario and demonstration of additionality for new sales RACs

15. Under this methodology a benchmark approach is applied using the tool referred above under paragraph 8 (a) to establish the baseline scenario and demonstrate additionality, recognizing that one or several measures for GHG emission reductions may be undertaken within RAC sector.

16. As long as the electricity intensity of new RACs (e.g., kWh/litre/y or kWh/cooling capacity/y) of a particular class and design, introduced by the project activity, is lower than the benchmark established, the emission reductions for this class and design, calculated as per this methodology, are deemed additional. A separate assessment of additionality is therefore not required under this methodology. This approach is in line with the approved "Guidelines for the establishment of the sector specific standardized baselines"

5.2.2. Identification of baseline for projects involving replacement refrigerators

17. For project activities that involve replacement of existing refrigerators, the baseline scenario is the continuing operation of the existing equipment. In the absence of the CDM project activity, the existing refrigerators would continue to provide services to historical average levels until the time at which it would be likely to be replaced in the absence of the CDM project activity. For the refrigerators whose life time has expired, the baseline shall be based on the approach used for new-sales refrigerators. The remaining lifetime of appliances shall be estimated using the procedure provided in the following section.

5.3. Procedure for estimating the remaining lifetime of existing refrigerator

18. **Step 1**: Determine the average age of the replaced refrigerators: The average age of the replaced refrigerators shall be determined using the nameplate information of at least 25 per cent of the replaced refrigerators based on all available data.

19. **Step 2**: Determine the typical average end-of-life and the remaining lifetime of the replaced refrigerators:

    (a) Where data from central disposal sites or recycling sites have been used to establish average end-of-life, the composition of models in those sites and among the replaced refrigerators shall be comparable. The remaining lifetime is determined by subtracting the average age of the replaced refrigerators from the average end-of-life.

    (b) Where the method described in paragraph 19(a) above is not feasible or data from central disposal sites or recycling sites to estimate the remaining lifetime is not available, apply the approach described in the Appendix, using Weibull distribution curve to establish remaining life-time, based on the average age of the refrigerators replaced; the following conditions apply:

        (i) Use Weibull distribution curves for household refrigerators applicable for the region with a default average lifetime of 16 years;

        (ii) Where Weibull distribution is not available for the region, apply a typical Weibull distribution curve with a default average lifetime of 16 years. Appendix provides a typical Weibull distribution curve and examples to estimate remaining life time.

5.4. Calculation of baseline emission

5.4.1. Baseline calculation for new-sales refrigerators

20. This baseline applies to projects which introduces new refrigerator appliances without replacement. The equations for calculating baseline emissions are as follows:

Option 1:

21. Where specific annual electricity consumption per unit volume of baseline refrigerator models are available;

$$BE_y = \frac{\sum_i EF_{grid,y} \times n_{i,y} \times EC_{rn}}{(1 - TD_{loss,y})} \times V_{avg,i}$$ Equation (1)

Where:

BE_y	=	Baseline emissions in year *y* (tCO_2e)
EC_{rn}	=	Baseline electricity intensity factor (kWh/refrigerator/year or kWh/litre/year) as determined using approach 1 or 2 prescribed under section 4.1 Refrigerator new-sales of RAC Tool.
$TD_{loss,y}$	=	Average annual technical grid losses (transmission and distribution) during year *y* for the grid serving the locations where the devices are installed, expressed as a fraction as determined using Data/Parameter Table 1.
$EF_{grid,y}$	=	Emission factor of a grid (tCO_2/kWh) (as determined in Data/Parameter Table 2)
$n_{i,y}$	=	Number of refrigerator model i introduced by the project activity operating in year y (as determined in Data/Parameter Table 3)
$V_{avg,i}$	=	Average volume of refrigerator model i introduced in year y in Litres as determined in Data/Parameter Table 8. This value is needed only if approach 2 of section 4.1 of the RAC Tool is used.

Option 2:

22. Where Energy Efficiency Index (EEI) of baseline refrigerator models are available or can be calculated:

$$BE_y = \frac{\sum_i EF_{grid,y} \times n_{i,y} \times EEI_{rn}}{(1 - TD_{loss,y})} \times SAE_{avg,i}$$ Equation (2)

Where:

EEI_{rn}	=	Baseline Energy Efficiency Index (dimensionless) as determined using approach 3 prescribed under section 4.1 Refrigerator new sales of RAC Tool.
SAE_{avg}	=	Average standard annual electricity consumption of refrigerators introduced in year y as determined in Data/Parameter Table 9 (kWh/yr).

5.4.2. Baseline calculation for new-sales air-conditioners

23. This baseline applies to projects which introduces new air-conditioners without replacement. The equation for calculating baseline emissions are as follows:

$$BE_y = \frac{\sum_j EF_{grid,y} \times n_{j,y} \times EC_{an} \times P_{cap,j,y}}{(1 - TD_{loss,y})} \quad \text{Equation (3)}$$

Where:

BE_y	=	Baseline emissions in year *y* (tCO_2e)
EC_{an}	=	Baseline electricity intensity factor (kWh/air-conditioner/cooling capacity/year) as determined using one of the approaches prescribed under section 4.2 of the RAC Tool
$P_{cap,j}$	=	Cooling capacity of the project air-conditioner model j (kW) (as determined in Data/Parameter Table 4)
$n_{j,y}$	=	Number of air-conditioner model j introduced by the project activity (as operating in year y determined in data/parameter Table 5)

5.4.3. Baseline calculation for refrigerators replacement

24. This baseline applies to projects which replaces existing functional domestic refrigerators, with more energy efficient new units. The equation for calculating baseline energy consumption and emissions are as follows:

$$BE_y = \frac{\sum_k EF_{grid,y} \times n_{k,y} \times EC_{rr}}{(1 - TD_{loss,y})} \times V_{avg,i} \quad \text{Equation (4)}$$

Where:

BE_y	=	Baseline emissions in year *y* (tCO_2e)
EC_{rr}	=	Average specific electricity consumption of the existing refrigerators in kWh/litre/y as determined using one of the approaches prescribed under section 4.3 of RAC Tool
$n_{k,y}$	=	Number of refrigerator model k replaced by the project activity operating in year y (as determined in data/parameter Table 6)

5.4.4. Baseline calculations for refrigerant emissions in new-sales air-conditioners

25. Physical leakage of refrigerants from baseline air-conditioners are considered under this component. Only avoided emissions of HFCs are eligible under this methodology whereas avoided HCFC emissions are ineligible. This component is eligible for inclusion only when the penetration rate of refrigerants used in the project air-conditioners is less than 20 per cent in the host country, i.e. the market share of all air-conditioners using the same refrigerants as the refrigerants used in the project air-conditioners is under 20 per cent of all air-conditioners sold[3]. This shall be demonstrated based on the preceding one-year data from the start date of the project activity or the start date of validation, whichever is earlier.

26. Calculate the baseline emissions from refrigerants in air-conditioners using the following equation:

$$BE_{REF,y} = \sum_{j} n_{j,y} \times \left(SRCF \times P_{cap,j}\right) \times Q_{ref,BL}$$ Equation (5)

Where:

$BE_{REF,y}$	=	Baseline emissions due to leakage of refrigerants in year y (tCO2e)
$SRCF$	=	Specific refrigerant charge factor as determined using section 4.4 of RAC Tool (tCO2e/kW)
$n_{j,y}$	=	Number or air-conditioner model j introduced by the project activity operating in year *y* as determined in data/parameter table 5
$P_{cap,j}$	=	Cooling capacity of the project air-conditioner model j (kW) (as determined in Data/Parameter Table 4)
$Q_{ref,BL}$	=	Average physical leakage rates of refrigerants in baseline air-conditioners in the year *y* as determined using Refrigerant Tool.

5.5. Project activity emissions

27. Project emissions consist of electricity used in the project equipment and emissions from physical leakage of refrigerant from air-conditioners, determined as follows:

$$PE_y = EC_{PJ,y} \times EF_{grid,y} + PE_{ref,y}$$ Equation (6)

Where:

PE_y	=	Project emissions in year *y* (tCO2e)

[3] Example: A CDM project activity introduces new air-conditioners containing HFC-1234yf that displaces air-conditioners containing HFC with high GWP. The share of air-conditioners with HFC-1234yf among all air-conditioners sold in the market is below 20% (based on sales number not number of models) in the one-year period prior to the start date of the project activity. In this case, avoided emissions of HFCs are eligible for consideration.

$EC_{PJ,y}$	=	Total electricity consumption by refrigerators and air-conditioners introduced by the project activity in year y, as determining using paragraph 28 and 29 below
$PE_{ref,y}$	=	Project emissions from physical leakage of refrigerant from air-conditioners in year *y* (tCO_2e/y) as determined using equation 2 of the Refrigerant Tool

28. For refrigerators, project electricity consumption is determined as follows:

$$EC_{PJ,y} = \frac{\sum_j n_{i,y} \times EC_{ref,y}}{(1 - TD_{loss,y})}$$ Equation (7)

Where:

$EC_{ref,y}$	=	Electricity consumption of refrigerators in project activity in year y (kWh) as determined in data/parameter Table 7

29. For air-conditioners, project electricity consumption is determined as follows:

$$EC_{PJ,y} = \frac{\sum_j n_{j,y} \times P_{cap,j} \times hrs_y \times \beta_L}{(1 - TD_{loss,y}) \times EER_{P,avg}}$$ Equation (8)

Where:

$P_{cap,j}$	=	Cooling capacity of the project air-conditioners j (kW) (as determined in data/parameter Table 4)
hrs_y	=	Annual average operating hours or usage (number, see data/ parameter table 10)
β_L	=	Load factor (proportion, see data parameter table 11)
$EER_{P,avg}$	=	Average energy efficiency ratio (W/W) of the project air-conditioners as determined in data/parameter Table 12)

5.6. Leakage

30. Leakage associated with the destruction of refrigerants from the displaced air-conditioners shall be determined using Refrigerant Tool.

5.7. Emission reduction

31. The emission reduction achieved by the project activity shall be determined as the difference between the baseline emissions and the project emissions and leakage.

$$ER_y = (BE_{y,} + BE_{REFy} - PE_y) - LE_y$$ Equation (9)

Where:

ER_y	=	Emission reductions in year *y* (tCO_2e)
LE_y	=	Leakage emissions in year *y* (tCO_2e)

6. Monitoring methodology

6.1.1. Data and parameters not monitored during the crediting period

Data / Parameter table 1.

Data / Parameter:	$TD_{loss,y}$
Data unit:	Fraction
Description:	Transmission and distribution of loss of electricity system supplying to project activities.
Source of data:	The average annual technical grid losses shall be determined using recent, accurate and reliable data available for the host country. This value can be determined from recent data published either by a national utility or an official governmental body. The reliability of the data used (e.g. appropriateness, accuracy/uncertainty, especially exclusion of non-technical grid losses) shall be established and documented by the project participant.
Measurement procedures (if any):	This value shall not include non-technical losses such as commercial losses (e.g. theft). A default value of 0.1 shall be used for average annual technical grid losses, if no recent data are available or the data cannot be regarded accurate and reliable.
Any comment:	-

6.1.2. Data and parameters monitored during the crediting period

Data / Parameter table 2.

Data / Parameter:	$EF_{grid,y}$
Data unit:	tCO_2/kWh
Description:	CO_2 emission factor of the grid electricity in year *y.*
Source of data:	As per the requirements in “Tool to calculate the emission factor for an electricity system”.
Measurement procedures (if any):	As per the requirements in “Tool to calculate the emission factor for an electricity system”.
Any comment:	-

Data / Parameter table 3.

Data / Parameter:	$n_{i,y}$
Data unit:	Number

Description:	Number of refrigerator model i introduced by the project activity operating in year *y.*
Source of data:	Project activity monitoring and documentation.
Measurement procedures (if any):	Annual/biennial checks that refrigerators are still working, done with a statistically significant sample of end-users. Use 90/10 and 95/10 confidence/precision for annual and biennial checks, respectively. The sample size shall be estimated following the requirements under “Standard on sampling and surveys for CDM project activities and PoAs”.
Any comment:	The CDM-PDD or CDM-PoA-DD/CPA-DD shall explain the proposed method of distribution of refrigerators to be conducted and documented. The CDM-PDD or CDM-PoA-DD/CPA-DD shall also explain how the proposed procedures eliminate double counting of emission reductions, for example due to manufacturers, wholesale providers or others possibly claiming credit for emission reductions from the project activities.

Data / Parameter table 4.

Data / Parameter:	$P_{cap,j,}$
Data unit:	kW
Description:	Average cooling capacity of the air-conditioner model j.
Source of data:	Manufacturer information or retailer information or reported as per efficiency label.
Measurement procedures (if any):	
Any comment:	

Data / Parameter table 5.

Data / Parameter:	$\boldsymbol{n_{j,y}}$
Data unit:	Number
Description:	Number of air-conditioner model j that are operating in year *y.*
Source of data:	Project activity monitoring and documentation.
Measurement procedures (if any):	Annual/biennial checks that air-conditioners are still working, done with a statistically significant sample of end-users. Use 90/10 and 95/10 confidence/precision for annual and biennial checks, respectively. The sample size shall be estimated following the requirements under “Standard on sampling and surveys for CDM project activities and PoAs”.

Any comment:	The CDM-PDD or CDM-PoA-DD/CPA-DD shall explain the proposed method of distribution of air-conditioners will be conducted and documented. The CDM-PDD or CDM-PoA-DD/CPA-DD shall also explain how the proposed procedures eliminate double counting of emission reductions, for example due to manufacturers, wholesale providers or others possibly claiming credit for emission reductions from the project activities.

Data / Parameter table 6.

Data / Parameter:	$n_{k,y}$
Data unit:	Number
Description:	Number of refrigerators model k replaced by the project activity operating in year *y.*
Source of data:	Project activity monitoring and documentation.
Measurement procedures (if any):	Annual/biennial checks that units are still working, done with a statistically significant sample of end-users. Use 90/10 and 95/10 confidence/precision for annual and biennial checks, respectively. The sample size shall be estimated following the requirements under “Standard on sampling and surveys for CDM project activities and PoAs”.
Any comment:	The number and “volume” of the replaced refrigerators shall be recorded in a way that allows for a physical verification by a designated operational entity (DOE). The CDM-PDD or CDM-PoA-DD/CPA-DD shall explain the proposed method of distribution of refrigerators and how collection and destruction of baseline refrigerators will be conducted and documented. The CDM-PDD or CDM-PoA-DD/CPA-DD shall also explain how the proposed procedures eliminate double counting of emission reductions, for example due to manufacturers, wholesale providers or others possibly claiming credit for emission reductions from the project activities.

Data / Parameter table 7.

Data / Parameter:	$EC_{ref,y}$
Data unit:	kWh
Description:	Annual electricity consumption of the refrigerators introduced by the project activity.
Source of data:	Manufacturer’s specification.
Measurement procedures (if any):	
Any comment:	Only the values determined using national test standard or IEC62552 or equivalent is eligible for use. Conversion factors provided in RAC Tool Appendix 1 Table 2 apply.

Data / Parameter table 8.

Data / Parameter:	$V_{avg,i}$
Data unit:	Liters
Description:	Average volume of refrigerators model i in year *y.*
Source of data:	For refrigerators introduced by the project activity: Project activity monitoring and documentation, model specifications from manufacturers. For all refrigerators in the market: Data for all models from Standard & Labelling database, commercial database, importers, retailers or manufacturer specifications.
Measurement procedures (if any):	
Any comment:	-

Data / Parameter table 9.

Data / Parameter:	SAE_{avg}
Data unit:	kWh/yr
Description:	Average standard annual electricity consumption of the project refrigerators year *y.*
Source of data:	For refrigerators introduced by the project activity: Project activity monitoring and documentation, model specifications from manufacturers. For all refrigerators in the market: Data for all models from Standard & Labelling database, commercial database, importers, retailers or manufacturer specifications.
Measurement procedures (if any):	
Any comment:	-

Data / Parameter table 10.

Data / Parameter:	hrs_y
Data unit:	Hours
Description:	Annual average operating hours or usage (in a country or a climatic zone).
Source of data:	In accordance with Data/Parameter Table 6 of the RAC Tool.
Measurement procedures (if any):	Where a survey is applied, sampling should be as per Guidelines for sampling and surveys for CDM project activities and programme of activities. The operating hours of the project air-conditioners shall be determined using hour meters or similar devices.
Any comment:	

Data / Parameter table 11.

Data / Parameter:	β_L
Data unit:	Load factor
Description:	Proportion of hours per year during the cooling periods of the year when air-conditioners operate at full capacity.
Source of data:	In accordance with Data/Parameter Table 7 of the RAC Tool
Measurement procedures (if any):	In accordance with Data/Parameter Table 7 of the RAC Tool

Data / Parameter table 12.

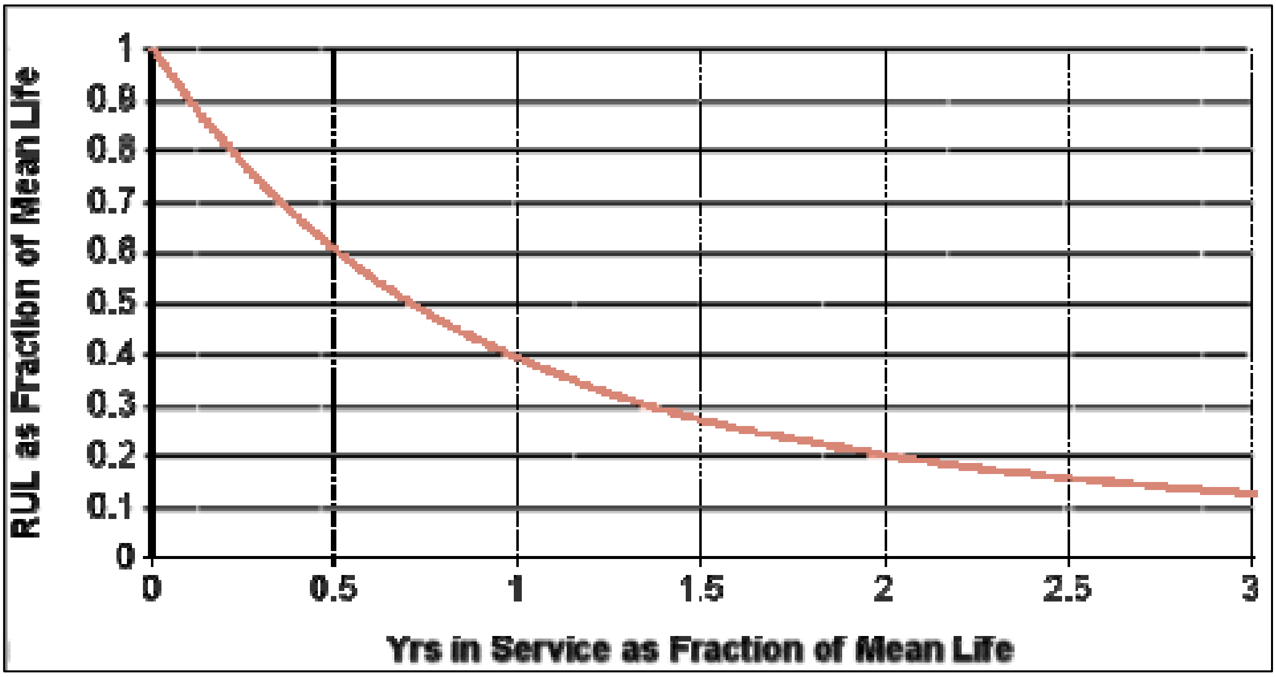
Data / Parameter:	*EER or SEER*
Data unit:	decimal (Wth/Welec)
Description:	Energy Efficiency Ratio or Seasonal Energy Efficiency Ratio
Source of data:	(a) Standard & Labelling database; (b) Commercial marketing data; (c) Manufacturers (industry) data; (d) efficiency labels on the equipment.
Measurement procedures (if any):	Only efficiency metrics determined by applying ISO5151(any version) are eligible to use. All national standards are based on ISO5151. For using SEER data, the conversions in Appendix 3 RAC Tool shall be used.
Any comment:	-

Appendix. Application of Weibull Distribution to estimate remaining life time of refrigerators

1. A Weibull distribution is a probability distribution function. It is often applied to estimate lifetime and reliability of mechanical and electronic equipment. For appliance survival rates, Weibull distributions are used instead of normal or linear distributions. Weibull distributions imply that the occurrence of an event in any part of an object may be said to have occurred in the object as a whole, statistical or dynamical strengths, electrical insulation breakdowns, life of lightbulbs, as the probability of surviving depends on the probability of not succumbing to many possible causes for failure (Lutz et al.2011).

2. Household appliances have similar curves, the Weibull Shape Factor for dishwashers is 2.18, refrigerators 2.15, freezers 2.46, cloth washers 2.31. Such results have been widely studied from large household survey data in Canada and the US. Because the Shape Factors fall in a narrow range, in the absence of particular mortality curve data, the average lifetime can provide the remaining useful life as a function of years in service with minimal uncertainty. An average of 2.34 for the Shape Factor is generally used to define the remaining useful life as a function of the years an appliance has been in service.

Figure 1. Typical Weibull distribution curve derived for household refrigerators



Note: RUL: Remaining useful life

Source: Welch C and Rogers B, 2011

3. The table below provides an illustrative example on determining remaining life time of refrigerators based on average age of functioning refrigerators.

Table 1. Example application of Weibull distribution curve

1	Average age of functioning refrigerators: 24 years Data source: Based on the nameplates information of at least 25 per cent of the replaced refrigerators based on all available data.
2	Years in service as a fraction of Mean life: 1.5 years Data source: Based on a default average lifetime of 16 years [24/16= 1.5].
3	Remaining Useful Lifetime as a fraction of Mean Life (RUL): 0.28 Data source: Estimated from the figure 1 above (The value 0.28 corresponds to 1.5 years in service as fraction of mean life).
4	Remaining Lifetime (RLT): 4.3 years Data Source: RLT= RUL (from 3 above) * Average lifetime (default =16 yrs) = 0.28 * 16 = 4.3 years RLT is the number of years for which the electricity savings / emission reductions from new refrigerators can be claimed, when a refrigerator replacement programme collects functioning refrigerators and retires them before these would be discarded otherwise.

4. Similarly, if the average age of a functioning refrigerator is 8 years old, years in service as a fraction of mean life will be 0.5 and the RLT would be 0.6 x 16 = 9.6 years.

1. References:

Welch C and Rogers B, 2011, "Estimating the Remaining Useful Life of Residential Appliances, ACEEE Summer Study on Energy Efficiency in Buildings",, Washington DC..]

Lutz JD, Hopkins A, Letschert V, Franco VH and Sturges A, 2011, "Using national survey data to estimate lifetimes of residential appliances", HVAC&R Research 17/5: 726-736.

Young D, 2008, "When do energy-efficiency appliances generate energy savings? Some evidence from Canada", Energy Policy, 36: 34-46.

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Document information

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01.0	4 September 2017	MP 74 electronic consultation report, Annex 1 To be considered by the Board at EB96. The draft version of this document (CDM-MP73-A05) was available for public input from 28 July to 11 August 2017. It received one input.

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