Indicative simplified baseline and monitoring methodologies
for selected small-scale CDM project activity categories

TYPE II - ENERGY EFFICIENCY IMPROVEMENT PROJECTS

Project participants shall apply the general guidelines to SSC CDM methodologies, information on additionality (attachment A to Appendix B) provided at <http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html> *mutatis mutandis*.

II.N. Demand-side energy efficiency activities for installation of energy efficient lighting and/or controls in buildings

Technology/measure

1. This methodology comprises activities in buildings for:

   (a) Retrofits of existing electric lighting fixtures, lamps, and/or ballasts with more energy-efficient fixtures, lamps, and/or ballasts;

   (b) Permanent de-lamping of electric lighting fixtures with or without the use of reflectors;

   (c) Installation of lighting controls, such as occupancy sensors or timers (with or without delamping or changes to fixtures, lamps, or ballasts) in order to reduce electric lighting lamp operating hours.

2. Only retrofit projects involving direct installation (or delamping) of equipment are allowable. Projects only involving the sale or distribution of efficient lighting systems and/or controls are not included under this methodology.

3. New construction (Greenfield) projects are not included under this methodology.

4. Projects involving variable dimming of lighting equipment (i.e. reduction in fixture/lamp wattage), for example, in response to daylighting controls, bi-level fixtures or adaptive dimming controls, are included under this methodology.

5. The following lighting technologies are not eligible as project activity under this methodology:

- T12 fluorescent light bulbs;
- Magnetic ballasts;
- Incandescent A-19 light bulbs;
- CFLs having lower than 6,000 hours lamp life;
- Recessed troffers with less than 70% fixture efficiency; and
- De-lamping without permanent removal of lamp holders.[1]

[1] To be eligible for this methodology, fixtures must be modified so that lamps cannot be reinstalled at a later date.

6. This methodology is applicable to non-residential and multi-family residential buildings supplied with grid electricity. Projects involving residential CFLs should use AMS-II.J "Demand-side activities for efficient lighting technologies".

7. The aggregate energy savings by a single project may not exceed the equivalent of 60 GWh per year for electrical end use energy efficiency technologies.

8. Project equipment shall have the following warranties:

- Lamp warranty – 20,000 hours, rated for 3 hour start up, using instant start ballast or 24,000 hours, rated at 3 hour start up, using program start ballast;
- Electronic Ballast warranty - 5 years;
- Lighting fixture warranty will be 10 years;
- LED lamps – 3 years, $L_{70} \geq$ 25,000 hours,[2] and
- LED fixtures – 5 years, $L_{70} \geq$ 36,000 hours.

At a minimum, warranties shall cover free replacement or repair of any failed equipment. The Project Design Document (PDD) shall explain how, through a maintenance and replacement program, failed equipment will be replaced by equipment of the same or better specification to that of any failed project equipment.

9. The project proponent shall ensure that the project lighting equipment and/or controls meet the following requirements:

(a) Provide an equivalent level of service to either: (a) baseline lighting systems; or (b) meet the requirements of ISO 8995 (International Standard for Lighting for Indoor Work Spaces)[3] or a relevant host country national standard for lighting levels and quality. Manufacturer specification sheets for fixture, lamp and ballast can be used to determine equivalent illuminance levels: (Fixture efficiency x lamp lumens x number of lamps x ballast factor = fixture lumens). A methodology utilizing weighted averages of measurements at specific points can be used for determining average illuminance, as indicated by the current version of the Lighting Handbook of the Illuminating Engineering Society of North America (IESNA);[4]

[2] L70 is the number of hours to reach 70% lumen maintenance, e.g. if lamp has 750 initial lumens, after 25,000 hours it would have at least 525 lumens or 30% loss of initial lumens.

[3] International Commission on Illumination (CIE), Lighting of Indoor Work Spaces, ISO 8995:2002(E), CIE S 008/E-2001, pages 9-17, or current version at time of project registration.

[4] Illuminating Engineering Society of North America (IESNA), The Lighting Handbook, Tenth Edition: Reference and Application, published by IESNA, 2011, page9.27-9.29.

(b) If LEDs will be utilized, to replace T8 or T12 lamps, the LEDs must initially provide 15% more lumens than the existing T8s and/or 10% more lumens than the existing T12s to account for lumen depreciation over time. LED lumens shall be measured initially after project installation. A methodology utilizing weighted averages of measurements at specific points can be used for determining average illuminance, as indicated by the current version of the Lighting Handbook of the Illuminating Engineering Society of North America (IESNA). This requirement is not applicable if the project LEDs are installed with dimming controls such that the lumen output can be raised to equal or exceed existing, baseline light levels;

(c) Are directly installed and tested to be functional at the time of installation by the project proponent or its representative.

10. The PDD shall explain the proposed method of direct installation and maintenance of project equipment.

11. Collection, destruction and/or recycling of baseline devices are required and the PDD shall explain the method for such, including how verification will be achieved. An example method is collection of baseline devices, storage in decentralised or centralised locations, and destruction by third-party recycling facility with certificate of disposal of all salvaged and scrap materials. With recorded documentation of baseline device destruction, the destruction can precede verification.

12. The PDD shall also explain how project procedures eliminate any possible double counting of emission reductions, for example due to manufacturers, wholesale providers or others possibly claiming credit for emission reductions for the project devices.

Boundary

13. The project boundary is the building, including building heating and cooling systems, where the lighting project is implemented.

Crediting period

14. With this methodology, Certified Emission Reductions (CERs) can be earned for one crediting period of up to 10 years

Emission reductions

15. Emission reductions are calculated as the net energy savings associated with:

(a) Reduction in the amount of electricity required for lighting, multiplied by an emission factor for the electricity displaced;

(b) Reduction, or increase, in the amount of fossil fuel and/or electricity required for building heating and/or cooling caused by interactive effects, multiplied by appropriate emission factors.

16. With respect to determining reduction in the amount of electricity required for lighting:

(a) Baseline surveys are required to document the spaces (e.g. rooms) in each project building where project activities will occur; the appropriate usage area designation (e.g. private offices, common offices, and hallways) for each of these spaces in the project building; the identification of and number of baseline fixture, lamp, ballast types and ballast factors in each space including counts of operating and non-operating fixtures; lighting control type in each space; and whether the spaces are air-conditioned and/or heated. Baseline surveys of energy usage may also be documented by sampling the energy consumption of randomly selected, representative lighting circuits.

Project surveys are required at the time of project installation and per the monitoring requirements of this methodology to document, in each project building, the identification of and number of project fixture, lamp, ballast types and ballast factors in each building space including counts of operating and non-operating fixtures; lighting control type in each space; and to confirm whether the spaces are air-conditioned and/or heated. Project surveys of energy usage may also be documented by sampling the energy consumption of randomly selected, representative lighting circuits.

Such documentation shall be provided in an organized table format. See Appendix 1 for sampling requirements;

(b) The surveys shall identify any non-operating fixtures. Non-operating fixtures are those that are typically operating but that have broken lamps, ballasts, and/or switches that are intended for repair. A de-lamped fixture is not a non-operating fixture; thus, de-lamped fixtures should have their own unique designations in the baseline and project surveys.

Fixtures that have been disabled or de-lamped or that are broken and not intended for repair should not be included in the calculation of baseline energy consumption. They should, however, be noted in the lighting survey to avoid confusion.

For non-operating fixtures, the baseline electricity consumption may be adjusted by using values for equivalent operating fixtures. The adjustment for non-operating fixtures will be limited to no more than ten percent (10%) of the total number of lighting fixtures in a building. If more than 10% of the total number of fixtures is non-operating, the number of fixtures beyond 10% will be assumed to have a baseline fixture wattage of zero.

All project fixtures, however, that are non-operating shall be considered to be operating for the purposes of calculating project energy use;

(c) Lighting level measurements or specification sheets are required for all projects to ensure that the project lighting systems meet the requirements of paragraph 9. Lighting levels are measured once for a statistically valid, representative sample of

spaces with the baseline lighting systems and once for a statistically valid, representative sample of the same spaces with the project lighting systems. These measurements shall be taken during non-daylight hours. See Appendix 1 for sampling requirements;

(d) For projects not involving lighting controls, the operating hours of the fixtures are assumed to be the same for the baseline and project scenarios and are based on values determined after project installation. Operating hours are measured for a statistically valid, representative sample of project fixtures after project installation and throughout the crediting period either at regular intervals or continuously.

For projects involving lighting controls the operating hours of the fixtures are not assumed to be the same for the baseline and project scenarios. Baseline operating hours are measured for a statistically valid, representative sample of baseline fixtures during representative periods prior to the project installation. Project operating hours are also measured for a statistically valid, representative sample of project fixtures during representative periods after project installation and throughout the crediting period either at regular intervals or continuously.

In all cases the monitoring time period(s) must be representative of annual conditions and account for seasonal variations in occupancy (such as in schools which are not in session during summer months or vacation periods). See Appendix 1 for sampling requirements. See Appendix 2 for operating hour measurement requirements for occupancy sensors and automatic timers and see Appendix 3 for operating hour measurements for bi-level and wireless controls where there is a change in wattage;

(e) Baseline and project fixture wattages will be determined using one of the following methods:

(i) Measurements of fixture wattage for a representative sample of fixtures in each project building;

(ii) Measurement of all or a representative sample of lighting circuits (non-lighting loads should be excluded when lighting circuits are measured) in each project building (in which case energy use will be determined as a combined value for fixture wattages and fixture operating hours); or

(iii) Provision of manufacturer documentation on wattages for the exact baseline and project fixture/ballast and ballast factor/lamp combinations.

See Appendix 3 for lighting circuit energy consumption metering requirements.

17. Interactive effects for heating must be assessed and accounted for in the emission reduction calculations for buildings that have space heating systems (which may reduce energy savings) and may be assessed and accounted for in buildings that have space air conditioning systems (which may increase energy savings). See Appendix 4 for interactive factor analysis requirements.

18. For the grid emission factor for electricity, an annual emission factor shall be calculated in accordance with the provisions in AMS-I.D "Grid connected renewable electricity generation".

19. The emission factor for fossil fuel shall be obtained from reliable local or national data if available; otherwise, IPCC default emission factors are to be used.

20. The following equations are used to determine lighting electricity savings for each fixture/lamp/ballast/ballast factor combination for each building in which a project is implemented:

Equation (1) is used when baseline and project fixture counts and wattages are surveyed and operating hours are monitored.

Equation (2) is used when baseline and project lighting circuits are monitored.

$$ES_y = \sum_{u,i}(1/1{,}000{,}000)*[(W/fixture_{b,u,i}*N_{b,u,i}*Hours_{b,u,i})-(W/fixture_{p,u,i}*N_{p,u,i,y}*Hours_{p,u,i,y})] \quad \textbf{(1)}$$

$$ES_y = \sum_{j}[(1/1{,}000)*[(AveragekWh_{b,j})_{baseline}-(AveragekWh_{p,j,y})_{project}] \quad \textbf{(2)}$$

Where:

ES_y	Lighting energy savings associated with project in year *y* (MWh)
$W/fixture_{b,u,i}$	Baseline lighting demand per fixture of type *i* in usage group *u*, Watts
$W/fixture_{p,u,i}$	Project lighting demand per fixture of type *i* in usage group *u*, Watts (for projects that involve only lighting controls, this value may be same for project and baseline)
$N_{b,u,i}$	Quantity of baseline affected fixtures, adjusted for inoperative lighting fixtures, of type *i* in usage group *u*
$N_{p,u,i,y}$	Quantity of project affected fixtures of type *i* in usage group *u* (for controls and efficiency projects, this value may be same for project and baseline) in operation in year *y*
$Hours_{b,u,i}$	Baseline annual operating hours for operative lighting fixtures, of type *i* in usage group *u*, hours and adjusted to represent an annual value. For efficiency only projects (no controls), this value equals $Hours_{p,u,i,y}$
$Hours_{p,u,i,y}$	Project annual operating hours for operative lighting fixtures, of type *i* in usage group *u*, hours in year *y* adjusted to represent an annual value

u	Building usage groups with similar operating hour characteristics, for example private offices, conference rooms, hallways, and storage areas. Building usage areas will be identified for areas with comparable average operating hours, as determined by the lights operating during the year or by each of the electric utility's costing periods. Usage areas must be defined in a way that groups together areas that have similar occupancies and lighting operating-hour schedules
i	Unique fixture/lamp/ballast combinations
$AveragekWh_{b,j}$	Lighting baseline energy use based on lighting circuit time period measurements, adjusted to represent an annual value, for lighting circuit j
$AveragekWh_{p,j,y}$	Lighting project energy use based on lighting circuit time period measurements, adjusted to represent an annual value in year y, for lighting circuit j
j	All or all representative lighting circuits in project building(s)

21. For projects involving lighting controls, if the number of Project annual operating hours is lower than the number of baseline annual operating hours in equation (1), or if equation (2) is used, the project proponent must explain why and how the reduction in operating hours and thus energy consumption is due to the project activity. For example, reductions in operating hours, and energy use, cannot be due to a lower building occupancy or changes in use of the building. If such changes have occurred new Baseline operating hours can be established through surveys.

22. Emission reductions are calculated with equations (3) and (4) for each building in which a project is implemented. Interactive factors are considered for buildings with electric or fossil fuel based heating and/or cooling systems.

$$ER_y = [ES_y * (1 + IF_{e,c} + IF_{e,h}) * \frac{3600{,}000kJ}{1MWh} * EF_{CO2,ELEC,y} / (1 - l_Y)] + TIF_y \quad \textbf{(3)}$$

$$TIF_y = [(ES_y * IF_{ff,c} * EF_{CO2,ff,c}) + (ES_y * IF_{ff,h} * EF_{CO2,ff,h})] * \frac{3600{,}000kJ}{1MWh} \quad \textbf{(4)}$$

Where:

ER_y	Emission reductions in year y, tCO_2
$EF_{CO2,ELEC,y}$	Grid electricity emission factor in year y
$IF_{e,c}$	Interactive factor for electric space cooling system impacts in building in which project is implemented, positive fraction. Factor takes into account the efficiency of the cooling system(s). Fraction is zero if building has no electric space cooling. See Appendix 4

$IF_{e,h}$	Interactive factor for electric space heating system impacts in building in which project is implemented, negative fraction. Factor takes into account the efficiency of the heating system(s). Fraction is zero if building has no electric space heating. See Appendix 4
$IF_{ff,c}$	Interactive factor for fossil fuel based space cooling system impacts in building in which project is implemented, positive fraction. Factor takes into account the efficiency of the cooling system(s). Fraction is zero if building has no fossil fuel based space cooling. See Appendix 4
$IF_{ff,h}$	Interactive factor for fossil fuel based space heating system impacts in building in which project is implemented, negative fraction. Factor takes into account the efficiency of the heating system(s). Fraction is zero if building has no fossil fuel based space heating. See Appendix 4
l_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. This value shall not include non-technical losses such as commercial losses (e.g. theft/pilferage). 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. 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. 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
TIF_y	Thermal Interactive Effect
$EF_{CO2,ff,c}$	Emission factor for fossil fuel(s) used in cooling system(s) (tCO_2/kJ)
$EF_{CO2,ff,h}$	Emission factor for fossil fuel(s) used in heating systems(s) (tCO_2/kJ)

23. In any given year, emission reductions can only be claimed for project lighting equipment and/or control systems that are demonstrated to be in place and operational on an annual or biennial (every other year) basis during the crediting period. Compliance with this requirement shall be implemented via an annual or biennial inspection of a sample of the equipment and systems that were installed during the installation period. When biennial inspection is chosen, following the inspection during the year of project installation, the inspections can be done in years 3, 5, 7, and 9 and the results of such inspections can be applied to crediting years 3 and 4, 5 and 6, 7 and 8, and 9 and 10, respectively (under this inspection scenario, the initial inspection results are valid for years 1 and 2). A statistically valid sample of the project fixtures and lamps (and as applicable, lighting control equipment and systems) in the building(s) where the project equipment and systems are installed can be used to determine the percentage of systems operating. Such percentage will be used to determine $N_{p,u,i,y}$ for each type of fixture in each usage group. That is $N_{p,u,i,y}$ equals the

number of project fixtures, of each type and in each usage group, documented to have been installed in the year of project implementation multiplied by the percentage of project fixtures found to installed and operating in year *y*.

Sample selection shall take into consideration occupancy type and schedules and space usage type differences, as per the relevant requirement for sampling in the latest version of the "Standard for sampling and surveys for CDM project activities and programme of activities".[5]

When biennial inspection is chosen at least a 95% confidence interval and 10% margin of error shall be achieved for the sampling parameter. When annual inspections are used, at least a 90% confidence interval and 10% margin of error shall be achieved for the sampling parameter.

While project equipment or systems replaced as part of a regular maintenance or warranty program can be counted as operating, project equipment or systems cannot be replaced as part of the survey process and counted as operating.

In addition, the annual or biennial inspections shall:

(a) Confirm the operation and estimated efficiency of building heating and/or cooling systems;

(b) Be used to determine and update the values for project fixture operating hours ($Hours_{p,u,i,y}$) or circuit energy consumption ($AveragekWh_{p,j,y}$).

Project fixture wattages do not need to be re-evaluated after their initial determination at time of project implementation.

24. The following parameters shall be documented at time of project implementation.

(a) Number, type and wattage of project fixtures/lamps/ballasts/ballast factors and/or control systems installed under the project activity, identified by the manufacturer and model numbers and the date of supply for each space, and thus usage group, in the project building(s);

(b) The number and specifications of replaced fixtures/lamps/ballasts;

(c) Data to unambiguously identify the location of the equipment distributed under the project activity;

(d) Specification of which spaces in the project building(s) are heated and/or cooled with systems that consume electricity and/or fossil fuel and the characteristics, specifically the estimated annual efficiencies, of such systems taking into consideration related auxiliary equipment.

5 <http://cdm.unfccc.int/Reference/Standards/index_poa.html>

Project activity under a programme of activities

25. The methodology is applicable to a programme of activities, no additional leakage estimations are necessary.

Appendix 1

SAMPLING REQUIREMENTS

Sampling shall comply with the relevant requirements for sampling in the latest version of "Standard for sampling and surveys for CDM project activities and programme of activities". However, the requirements in the table below have precedence.

The following table indicates the surveys that are or may be required in accordance with this methodology for which a sample may be used versus a census.

Parameter to be determined	Survey Subject	When Completed	Notes
Operating hours	Last Point of Control for fixtures, see below for definition	(a) Baseline; (b) When project installation is completed; and (c) Repeated per paragraph 23	Sampling uses stratified random sampling, with usage groups defined as the stratum, see below for definition of usage groups
Lighting levels	Spaces where lighting retrofits are to occur or have occurred	One time each for baseline and project	Sampling uses stratified random sampling, with usage groups defined as the stratum
Number of operating fixtures	Lighting fixtures	(a) When project installation is completed; and (b) Repeated per paragraph 23	Sampling uses stratified random sampling, with usage groups defined as the stratum
Lighting energy use (MWh)	Lighting circuits	(a) Baseline; (b) When project installation is completed; and (c) Repeated per paragraph 23	Sampling is based on a statistically valid, representative set of lighting circuits in each building (for example 3 randomly selected floors in a 10 story office building), plus a lobby floor. Note that either operating hours of fixtures or lighting circuit energy use will be measured, but not both

Last Point of Control (LPC). The last point of control (LPC) is defined as the portion of an electrical circuit that serves a set of equipment that is controlled on a single switch. As a result, all of the fixtures or pieces of equipment on that LPC are typically operated the same number of hours per year. For metering purposes, it is assumed that measurements taken of a single light fixture or piece of equipment on an LPC captures the operating hours for all of the equipment served on the same circuit.

In the equations for determining sample sizes, the total number of LPCs in the project or building is denoted as the population for determining operating hours of fixtures. An example of an LPC would be a set of lighting fixtures in a room that operates on a single switch. If there were two separate switches controlling different groups of fixtures in the room, each one would constitute an LPC for the metering purposes.

Usage Group. A usage group is a subset of the whole population of affected equipment at the project site. Usage groups are designated for similar areas that have similar characteristics with respect to the lighting. This grouping technique subdivides a large group of spaces in a building into smaller groups that are more homogeneous and thus reduces the variance of the projected operating hours, or other factors, in each group.

Examples of standard usage groups for lighting projects are fixtures with similar operating characteristics in private offices, common offices, laboratories, hallways, stairwells, common areas, class rooms, perimeters, and storage areas.

Usage groups are not appropriately designated if they combine different functional groups with different operating patterns (e.g. offices and closets), lump smaller usage groups together (e.g. closets, storage, and utility rooms), or lump groups based on total annual hours but not operating function and pattern (e.g. offices and commons).

In some instances, area type alone may be insufficient to designate usage groups. Usage groups may need to be further subdivided if an area type is inherently variable because area occupants have very different characteristics. For example, some classrooms may have longer operating hours than others and should be subdivided, if information is available that predicts the operating hours (e.g. if computer classroom hours are 12 hours per day while typical classroom hours are 6 hours per day).

Usage groups will typically be defined for the population on a building-by-building basis. However, for some projects it may be reasonable to determine sample sizes across a number of buildings with similar usage areas. For example, if a project involves conducting lighting retrofits in multiple, similar barracks, then the usage groups of common sleeping areas, private sleeping areas, washrooms, etc. may be totaled for all the barracks. These values can be used to determine total population size for each usage group (assuming the usage group level sampling option is used). In applying this usage group stratified sampling approach, the samples would be selected from all the barracks. This would result in fewer monitoring points than if each building were considered separately.

Appendix 2

OPERATING HOUR MEASUREMENT REQUIREMENTS

Operating hours for lighting fixtures, for each Last Point of Control, are determined through measurements with run-time data loggers that indicate the number of hours that a light fixture is on (with a light sensor that records status of lights – on or off - in at least 5 minute increments). The number of hours the lighting fixtures are on will be recorded over a specific period of time and converted into annual hours. The specific period of time for recording operating hours must be at least four weeks, for each year when recording is required, during representative time periods of the year.

If the project lighting has indoor occupancy sensors or automatic timer controls, the specific period of time for recording operating hours must be at least eight weeks, for each year when recording is required, during at least two distinct representative time periods of the year.

Annual hours shall be determined from the recorded data with consideration of the following factors:

- Seasonal variation in operations;
- Seasonal variations if lighting controls are used near windows;
- Number of days the building is closed, such as on holidays or special events;
- Non-lighting loads;
- Anomalies that may have occurred due to broken equipment or unusual occurrences during monitoring period.

Appendix 3

LIGHTING CIRCUIT ENERGY CONSUMPTION MEASUREMENT REQUIREMENTS

Energy consumption data for lighting circuits, or for each Last Point of Control, are determined through measurements with calibrated power consumption meters. The power will be averaged, at a maximum, over 15 minute intervals throughout the metering period. The specific period of time for recording operating hours must be at least four weeks, for each year when recording is required, during representative time periods of the year.

A data logger will be necessary to measure electricity consumption (kWh) on the lighting circuit or control panel. For locations where wireless lighting controls system will be installed on a variety of lighting load types (private office, conference rooms, cubicles, open plan, etc.), at least one representative circuit for each configuration shall be monitored.

The amount of electricity consumed by the lighting fixtures will be recorded over a specific period of time and converted into annual hours. Annual energy consumption shall be determined from the recorded data with consideration of the following factors:

- Seasonal variation in operations;
- Seasonal variations if lighting controls are used near windows;
- Number of days the building is closed, such as on holidays or special events;
- Non-lighting loads;
- Anomalies that may have occurred due to broken equipment or unusual occurrences during monitoring period.

Appendix 4

REQUIREMENTS FOR DETERMINING INTERACTIVE EFFECTS

Lighting efficiency projects may have the added advantage of saving energy by reducing loads associated with space-conditioning (cooling) systems. However, the reduction in lighting load may also increase space-heating requirements. The following are considerations for determining energy savings or losses associated with the interactive effects of lighting efficiency projects:

(a) If a building includes only space cooling systems and no space heating systems, consideration of interactive effects is optional;

(b) If a building includes space heating systems, consideration of interactive effects is mandatory;

(c) Interactive effects are calculated as a negative or positive "interactive effect adder" to only the lighting systems (and their energy use) that are operating in conditioned spaces. For example, lighting in a hallway that is neither heated nor cooled will not have any interactive effects and this must be taken into account when utilizing equation (4) for Thermal Interactive Effect (TIF);

(d) Cooling and heating interactive effects are directly proportional to the reduction of building lighting energy consumption, ES_y. The cooling interactive factors ($IF_{ff,c}$ and $IF_{e,c}$) are calculated with the cooling fraction indicated in paragraph (e) below and with consideration of the efficiency of the building cooling system. The heating interactive factors ($IF_{ff,h}$ and $IF_{e,h}$) are calculated with one of the heating fractions indicated in paragraph (f) and with consideration of the efficiency of the building heating system;

(e) A default cooling fraction of 0.15 may be used for calculating $IF_{ff,c}$ and $IF_{e,c}$. For example, if a building is cooled with electric chillers that have a COP (coefficient of performance) of 3.0 then $IF_{e,c}$ will equal +0.05 (0.15/3.0). This fraction is only applied for the periods of times that the affected spaces are cooled. For example, lighting in a building that is not cooled during the winter, will not have any cooling interactive effects during the winter and this must be taken into account when utilizing $IF_{e,c}$ in equation (3) and $IF_{ff,c}$ in equation (4);

(f) The following table of default values for heating fractions may be used for calculating $IF_{ff,h}$ and $IF_{e,h}$. For example, if a building (in a region with less than 1,000 Heating Degree Days per year) is heated with an electric resistance heating system then $IF_{e,h}$ will equal -0.1 (-0.1 times 100 percent efficient system). Or, if a building is heated with a fossil fuel heating system with an 80% efficiency then $IF_{ff,h}$ will equal -0.125 (-0.1/0.80).

Number of Heating Degree Days per year (°C)	Heating fraction
Below or equal to 1000	-0.1
More than 1000 but below 2000	-0.2
More than 2000 but below 3000	-0.3
More than 3000 but below 4000	-0.4
More than 4000	-0.5

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History of the document

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