



Department
of Energy &
Climate Change

Appendix A: Deemed Measure Overviews and Data Calculations

Electricity Demand Reduction Pilot

Deemed Savings Manual - Measure overviews and
technical data and calculation sheets

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Any enquiries regarding this publication should be sent to us at edr-project@decc.gsi.gov.uk.

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Measure overviews and Technical data and calculation sheets

This document provides supporting material for the Deemed Savings Section of the M&V Manual

The full list of measures suitable for using the deemed savings methodology within the EDR pilot is as follows:

- **Heating controls** – installing controls which improve the control of electrically powered heating systems, including both direct electrical heating systems, and heat pump based systems.
- **Lighting controls** – installing controls to turn off or dim lighting based on occupancy detection.

Note that lighting replacement or lighting control projects may be carried out independently or as a combined measure (i.e. both new lighting and controls)

- **Lighting Replacement** – replacement of existing lighting with efficient, high frequency fluorescent, LED, induction or efficient high intensity discharge lighting.
- **Motors & Variable Speed Drives (VSDs)** – replacing existing AC single speed induction or permanent magnet synchronous motors with more efficient models and/or adding variable speed drive control to a motor installation
- **Process Chillers** – replacement of packaged chillers used for process cooling to produce chilled water or other liquids.
- **Professional Refrigerated Storage Cabinets (PRSC)** – replacement of refrigerated storage cabinets. PRSCs are specifically designed to store, but not to display, chilled and/or frozen foodstuffs.
- **Retail Display Cabinets (RDCs)** – replacement of retail display cabinets specifically designed to store and display chilled and/or frozen foodstuffs. RDCs enable the customer to view the foodstuff either through an opening in the cabinet, or through a transparent door or lid.

There are two broad types of deemed savings project, these are:

- replacement of existing equipment with new, more efficient replacements
- installation of add-on controls to improve the efficiency of an existing system

Replacement equipment

A replacement is where an existing item of equipment is being substituted with a new efficient alternative. The replacement equipment must be the same technology, but not necessarily of the same equipment specification. For motors and process chillers one for one replacement is

required. For all other technologies the number of equipment items being replaced and being purchased does not need to match. However, the replacement equipment must perform the same function and duty as the original equipment.

Add-on controls

Some products don't use energy in themselves, but reduce the energy use (and demand) of existing equipment. Variable speed drives, lighting controls and HVAC controls fall into this category.

The deemed savings approach can be used for control technology, but **only** where there is currently no control fitted. Replacement of existing controls cannot be claimed through deemed savings.

Technology Interactions

In a few cases the interaction between certain technologies will impact on the ability to accurately deem the amount of savings achievable. In this case the equipment will not be eligible under the deemed savings methodology and one of the other M&V approaches would need to be used. However for the pilot project most eligible equipment types can be combined.

Where a measure may lead to additional savings beyond the equipment being replaced, then the participant may choose to use an alternative M&V approach. For example, if the installation of new RDCs with doors would also reduce demand from electrical heating.

Where demand reduction projects involve a combination of deemed savings measures, and measures which use alternative M&V approaches, then advice should be sought in advance from your technology supplier in the first instance and then, if necessary, DECC to confirm eligibility of the particular combination concerned, and whether a combination of approaches is acceptable.

For each technology type on the deemed list this document contains:

- **Measure overview** – this defines the eligibility criteria for each of the technologies covered under the deemed savings approach. Please use this to confirm your project is suitable for the deemed savings approach and understand what information will be required to complete your submission and fill out the calculators.
- **Technical data/calculation sheets** – these provide information to show how the kW demand savings are determined within the spreadsheet calculator. They detail the formulae for the calculations; the deemed factors which are used, and a worked example calculation.

1. Process Chillers

Measure overview

Description

This measure allows for replacement of working process chillers. It covers factory-built pieces of refrigeration equipment which are primarily intended to cool down and maintain the temperature of a liquid (water or brine) using a vapour compression cycle within a refrigeration process, including at least a compressor and an evaporator within a “package”. This measure is limited to chillers intended for process cooling applications, being those that are generally designed to operate all year round, including in ambient temperatures below approximately +10°C, and optimised for efficient operation at 80% loading and above and for which the load is generally independent of ambient conditions.

Applicability

- This measure applies to the replacement of one or more currently working process chillers in one or more premises with more efficient products.
- The measure applies to products which are functioning 24hours per day, 5 or 7 days per week over their entire lifespans.
- The measure only applies where the existing and replacement chillers are <1MW capacity.
- The measure applies to “high temperature” chillers i.e. that the process chiller is capable of delivering its rated cooling capacity at an indoor heat exchanger outlet temperature of 7°C, at standard rating conditions;
- Replacement of a large chiller with several smaller units is not eligible for the deemed savings approach.

Exclusions

- This measure does not apply to chillers used in ventilation and air conditioning systems
- This measure does not apply to replacement of failed process chillers.
- This measure does not apply to the installation of process chillers in new premises or expansion of existing facilities i.e. increasing the overall capacity of process chillers.
- This measure does not apply to the installation of absorption process chillers
- This measure does not apply to “medium temperature” or “low temperature” chillers i.e. chillers in which the rated cooling capacity is delivered at an indoor heat exchanger outlet temperature of -8°C or -25°C at standard rating conditions;

Definitions

- Coefficient of Performance (COP) is a dimensionless number quantifying the efficiency of a given refrigeration system. It is the ratio between the net cooling capacity over the effective power input (kW).
- Cooling capacity is the total amount of cooling a given plant can supply (kW).

- Loading factor is the proportion of cooling capacity in utilisation by the plant (%).
- Refrigeration load is the product between the cooling capacity and the loading factor of the plant (kW).
- Performance of the units (i.e. COP) is usually tested by manufacturers according to BS EN 1511:2013 series under stated test conditions.

Completing the M&V Plan for Deemed Savings – Process Chillers

There are 3 tabs in the M&V Plan for Deemed Savings Process Chillers

- 1) Cover Sheet
- 2) Chiller Input Data Sheet
- 3) Help

Chiller Input Data Sheet:

Details of both the existing and replacement equipment should be entered into adjacent lines on a single “chiller input data sheet”. Only “one for one” chiller replacements are allowed using the deemed saving approach. You are required to input:

- Site Code
- Description and quantity of units
- Confirmation of whether the chillers are air or water cooled
- Whether free cooling is part of the existing and/or proposed measure
- The kW rating of the existing and proposed chiller(s)
- Age of the existing unit(s)
- The COP (co-efficient of performance) of the proposed chiller(s) when operating at an outlet temperature of 7°C
- Peak Applicability

Further details and help on how to source this information is found within the M&V Plan for Deemed Savings – Process Chillers

Information to support your deemed application

You must provide a copy of the manufacturer brochure or technical data sheets (or website link to them), or manufacturer declaration on headed paper, stating the COP value of the proposed equipment when operating at 7°C.

Technical data and calculation sheet - Process Chillers

Deemed Savings Formula & Tables

$$EDR_{savings} = kW_{existing} - kW_{proposed} \tag{1}$$

$$where\ kW_{existing} = \frac{Capacity_{proposed} \times load\ factor}{COP_{existing} \times free\ cooling\ factor \times ageing\ factor \times (1 - sizing\ factor)} \tag{2}$$

$$where\ kW_{proposed} = \frac{Capacity_{proposed}}{COP_{proposed}} \times (load\ factor) \tag{3}$$

Load factor = 0.8 (this average value should be used for all calculations)

Capacity_{proposed} = Cooling Capacity of the replacement chiller, as per manufacturer specification

COP_{proposed} = COP of the replacement chiller, as per manufacturer specification, stated at operational temperature of +7°C

COP_{existing} = COP of the current chiller. Look up on tables below, depending whether air or water cooled.

Free cooling factor = 1.3 if existing chiller has free cooling

Free cooling factor = 1.0 if existing chiller doesn't have free cooling

(It is assumed that if current chiller has free cooling, then its COP is estimated to be 30% higher than the average for COP_{existing})

Ageing Factor (years)	
0 to 5	1.00
6 to 10	0.94
11 to 15	0.90
16 to 20	0.86
21 to 25	0.82
Over 25	0.80

$$Capacity\ ratio = \frac{Capacity_{proposed}}{Capacity_{existing}} \times load\ factor$$

Sizing factor = assumed reduction in COP resulting from different loading level compared to 80% load. Look up value on table below based on capacity ratio.

Sizing factor:

Look up Capacity ratio	Sizing factor
>=0.8	0.00
0.7 to 0.79	0.01
0.6 to 0.69	0.06
0.5 to 0.59	0.14
0.4 to 0.49	0.23
>=0.39	0.33

COP_{existing}

Air Cooled Chiller Capacity _{existing}	COP _{existing}
High temp <400 kW	2.7
High temp >=400 kW	2.9

Water Cooled Chiller Capacity _{existing}	COP _{existing}
High temp <400 kW	4.4
High temp >=400 kW	4.8

Example calculation

Replacement of 1 x 150kW 12 year old air cooled chiller with 1 x 100kW new water cooled chiller with free cooling (COP 5.6).

	Existing units	Proposed units
COP	2.7 (from table)	5.6

Appendix A: Deemed Measure Overviews and Data Calculations

Free cooling factor	1	n/a
Ageing factor	0.9 (from table)	n/a
Capacity ratio	$=100/150 \times 0.8 = 0.533$	n/a
Sizing factor	$= 0.14$ (from table, using above capacity ratio)	n/a
kW	$=100 \times 0.8 / (2.7 \times 1 \times 0.9 \times (1-0.14))$	$=100 \times 0.8 / 5.6$
	$=38.28$	$=14.29$
Step 6	Peak kW savings = $38.28 - 14.29 = 23.99$ kW	

2. Heating controls

Measure overview

Description

This measure allows for the installation of new modern automatic heating controls that serve electrically driven heating systems.

Heating controls are used to regulate the environmental conditions (e.g. temperature) within a building or individual zones i.e. rooms or areas. They can be programmed to automatically maintain user-specified environmental conditions within pre-set limits in a manner that reflects occupation schedules, occupation status and/or level of activity in the zone, whilst also taking account of environmental conditions, and the specific operating requirements of the zone. Only the heating savings are included within the deemed savings approach and other measures under the “HVAC” category.

Applicability

- Only automatic controls that serve direct electric heating systems e.g. wall mounted panel heaters, quartz infrared heaters and electrically driven heat pump/VRF/VRV type systems are eligible.
- Only controls that provide improved control functionality over the existing control system are eligible.
- Controls may be stand-alone unitary controllers, centralised controllers or a building energy management system.
- Improved controls should include three or more of the following features that are not already available:
 - (a) More accurate time scheduling;
 - (b) Optimum on/off;
 - (c) Enforced switch-off at close of business e.g. BEMS interface with intruder detection;
 - (d) Remote supervisory control;
 - (e) Occupancy control;
 - (f) Tamperproof / restricted temperature sensors;
 - (g) Replacement of room thermostats with sensors;
 - (h) Remote supervisory control

Exclusions

- Projects will not be eligible where the existing control system(s) is/would be capable of providing the same functionality as the proposed system, but such capability is not being utilized e.g. having fallen into disuse, being manually over-ridden or have not been properly maintained.
- HVAC control upgrades that directly relate to air and/or water volume flow rate control savings arising from control of electric motors associated with centralised systems e.g. demand controlled ventilation, or duct static pressure reset control are not eligible. Installing variable speed drives (VSDs) to control heating fans and pumps is covered on a separate Motors and Drives spreadsheet calculator.
- Savings on fans, pumps, and heating using other fuels are not included in the savings calculation. Only electrical heating savings are covered through the deemed savings approach.

- Projects situated in residential premises are not eligible under deemed savings.

Definitions

Term	Description
Direct electric heating	Any form of electrical heating system that is used to provide real-time space heating e.g. wall mounted panel convector heaters, quartz radiant heaters
Heat pump	A system that employs a refrigerant cycle to draw heat energy from a cooler source e.g. external air, to provide space heating to an internal space. In this context only electrically driven systems are eligible.
VRF/VRV (Variable Refrigerant Flow/Variable Refrigerant Volume)	A system in which a single outdoor unit serves multiple indoor units each of which has an electronic liquid expansion valve to control refrigerant supply to match the demand of the space it serves. In this context only electrically driven systems are eligible.
Building Energy Management System (BEMS)	A micro-processor based system that can set and control the temperature and/or humidity in levels in multiple zones, allow for different time control to be exercised in each zone as well as providing other control and management functions e.g. control of lighting, monitoring of plant alarms.
Optimum start/stop	A control function that calculates the optimal time to switch on/off heating (or zone) according to thermal characteristics of the building and the desired temperature (and often the prevailing external conditions).
Time-switch	An electronic or electro-mechanical means of controlling the operating times of heating systems/equipment. These can range from simple 7-day timers with limited time resolution and switching periods to electronic controllers that allow multiple cycles per day to a high degree of resolution e.g. 1-minute.
Zone control	A means of exercising individual time and/or temperature control of an individual space that is served from a larger system.

Completing the M&V Plan for Deemed Savings – Heating Controls

There are 3 tabs in the M&V Plan for Deemed Savings Heating Controls

- 1) Cover Sheet
- 2) Data Input Sheet
- 3) Help

Data Input Sheet:

This calculator is to be used for the installation of new modern automatic heating controls that serve electrically driven heating systems.

For this calculator there is only one input sheet and you are required to enter one line of details per controls measure for each building type being controlled

- Building Name
- Confirmation of building type

- Site Code
- Type of electrical heating (direct, heat-pump/VRF)
- Details of existing and proposed controls
- Floor area (m²)
- Peak Applicability

Further details and help on how to source this information is found within the M&V Plan for Deemed Savings – Heating Controls

Information to support your deemed application

You must provide a copy of the manufacturer brochure or technical data sheets (or website link to them), detailing the control systems being installed.

Technical data and calculation sheet – Heating Controls

Deemed Savings Formula & Tables

$$EDR_{savings} = kW_{existing} \times (1 - ACF) \quad (1)$$

where:

$$kW_{existing} = \frac{\text{Heated Floor Area} \times IHCF \times SLF}{SCOP \times 1,000} \quad (2)$$

ACF = Assessed Control Factor

Heated Floor Area = Building or zone floor area affected by the enhanced controls (m²)

IHCF = Installed Heating Capacity Factor (Watts per m²)

SLF = System Load Factor=0.8 i.e. system deemed to be operating at 80% of its rated capacity

SCOP = Seasonal Coefficient of Performance = 1 for direct electric; 4 for heat pump/VRF

Installed Heating Capacity Factors (IHCF)

Building Type	Watts/m ²
Retail	100
Offices	70
Industrial	80
Educational	87
Other	70

Assessed Control Factor (ACF)

Enhancement	Control Factor
Improved time control	0.90
Closer temperature control	0.92
Time & temperature control improved	0.82

Example calculation

Offices having a heated floor area of 5,000m² served by multiple heat pump systems under basic local time and temperature (fixed time schedule and adjustable wall mounted thermostats) intend to install a mini Building Energy Management System to provide optimum start and stop time control, set-point enforcement and zone (time) control through occupancy detection. Office is open throughout the 4-8pm peak period, 5 days per week.

$$EDR_{savings} = kW_{existing} \times (1 - ACF)$$

where:

$$kW_{existing} = \frac{\text{Heated Floor Area} \times IHCF \times SLF}{SCOP \times 1,000}$$

$$kW_{existing} = \frac{5000 \times 70 \times 0.8}{4 \times 1,000}$$

$$kW_{existing} = 70 \text{ kW}$$

$$EDR_{savings} = 70 \times (1 - 0.82)$$

$$EDR_{savings} = 12.6 \text{ kW}$$

3. Lighting and lighting controls

Measure overview

Description

This measure allows for replacement of functional existing luminaires and lamps with high efficiency lighting units including light emitting diode units. This measure also allows for the inclusion of lighting control within a lighting project or as a separate project.

High efficiency lighting units are products that are specifically designed to provide energy efficient illumination e.g. T5 fluorescent lighting units. Units are a combination of a light fitting, one or more lamps, and associated control gear that have been assembled either into a single packaged unit or a luminaire with remote control gear.

Light emitting diode (LED) lighting units are products that are specifically designed to provide light by means of solid-state lighting devices. LED lighting units are products that consist of one or more LEDs incorporated into a light fitting (or luminaire) and includes associated electronic control gear. The luminaire generally also includes an optical system that reflects and/or focuses the product's light output onto the item(s) being illuminated.

Lighting controls are products that are specifically designed to switch electric lighting on or off, and/or to dim its output. Lighting controls enable electric lighting levels within specific areas to be adjusted, as and when required by changes in occupancy or daylight, or individual activities. A wide variety of lighting control products are available, and these range from simple manual switches to fully automatic control systems that adjust electric lighting levels to reflect planned operating hours, occupation levels and the availability of daylight in specific areas.

Applicability

- This measure applies to the upgrade of lighting systems with more efficient products, which may include lighting controls.
- Both current and proposed systems should illuminate the same areas
- Lighting units must have a luminaire efficacy that is greater than or equal to the thresholds set out in the 2013 Non-domestic building services compliance guide which supports Part L of the Building Regulations.
http://www.planningportal.gov.uk/uploads/br/non_domestic_building_services_compliance_guide.pdf
- All products must have a power factor greater than, or equal to, 0.7 at all levels of product light output
- This measure must include the installation of products to meet the sufficient minimum light levels required according to HSG38 - Lighting at Work
<http://www.hse.gov.uk/pubns/books/hsg38.htm>
- It is expected that the design of the new lighting and/or control system conforms to good lighting practice, and that the installation has been designed by a competent professional (for example the area is not over-lit, and the level of control is adequate to ensure that individual lighting zones dim or turn off when not required).

Note:

Measures involving luminaire replacements should be completed on the lighting replacement spreadsheet calculator. Measures which only involve fitting controls to existing lighting, should be entered onto the lighting controls only spreadsheet calculator.

Exclusions:

- This measure does not apply to replacement of failed lighting systems or the introduction of new lighting systems where a system didn't exist before
- This measure only includes replacement of whole luminaires. Replacement of lamps within existing luminaires is not eligible.
- This measure does not apply to new buildings or currently un-lit spaces of existing buildings
- This measure does not apply to projects which solely introduce photocell/daylight controls
- The proposed lighting systems must not illuminate different buildings and/or building areas; no benefit is attributable to the removal of existing lighting from unused areas.

Definitions

- Light Sources - Defined according to the details in Table 1 below
- Lighting Controls - Defined according to the details in Table 2 below
- Luminaire – The whole light fitting and associated lamp(s) and control gear
- Lamp Rating – The stated watts (W) given for the luminaire
- Efficacy – Luminaire efficiency defined by lumens of light output emitted by the luminaire per circuit watt of electrical power consumed

Completing the M&V Plan for Deemed Savings – Lighting Replacement

There are 4 tabs in the M&V Plan for Deemed Savings Lighting Replacement

- 1) Cover Sheet
- 2) Existing Lighting System
- 3) Proposed Lighting System
- 4) Help

There are two separate data input tabs, one for the existing equipment and one for the proposed. On the existing lighting system sheet you should fill out one line for every different luminaire, or group of identical luminaires being replaced. On the proposed units tab you should fill out one line for every different replacement product (or group of identical products).

- Building type & location within building of the proposed installation
- Site Code
- Existing and proposed lighting source types
- Accurate quantities of existing and proposed luminaires/lamps
- Accurate wattages for existing and proposed luminaires/lamps
- Lighting control details (if part of the existing system and/or proposed installation)
- Peak Applicability

Further details and help on how to source this information is found within the M&V Plan for Deemed Savings – Lighting Replacement

Information to support your Lighting Replacement application

You must provide a copy of the manufacturer brochure or technical data sheets (or website link to them), detailing the technical specification of the luminaire/lamps being installed within this measure.

Completing the M&V Plan for Deemed Savings – Lighting Controls

There are 4 tabs in the M&V Plan for Deemed Savings Lighting Replacement

- 1) Cover Sheet
- 2) Lighting System Details
- 3) Help

This calculator should only be used for lighting control installation, in which the luminaires are not being replaced. You should fill out the details of the existing lighting system and confirm the type of lighting controls being installed as shown in the example on the calculator. You are required to input:

- Building Name
- Site Code
- Confirmation of Building Type
- Location within Building
- Existing lighting source types
- Accurate quantities of existing luminaires and lamps per luminaire
- Accurate wattages of existing luminaires/lamps
- Existing and proposed lighting control details
- Peak Applicability

Further details and help on how to source this information is found within the M&V Plan for Deemed Savings – Lighting Controls

Information to support your Lighting Controls application

You must provide a copy of the manufacturer brochure or technical data sheets, or website link to them, detailing the technical specification of the controls being installed within this measure.

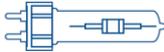
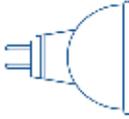
Light Source	Control Gear	Description	Image
T12 Fluorescent	Switch start	38mm diameter fluorescent tube typically found in older lighting systems.	
T8 - Fluorescent	Switch start	Commonly used 26mm diameter fluorescent tube – available with switch-start or high frequency control gear.	
	HF standard		
	HF dimming		
T5 - Fluorescent	HF standard	More modern 16mm diameter fluorescent tube.	
	HF dimming		
Compact Fluorescent (single ended)	Switch start	Used commonly in down-lights and bulkhead luminaires – available with switch-start or high frequency control gear.	
	HF standard		
	HF dimming		
High intensity discharge (HPS & Metal Halide <200W)	Electro magnetic	Commonly used discharge lighting including either high pressure sodium (HPS) or metal halide. Available with electro-magnetic, electronic or hybrid ballasts depending on type and size.	
	Electronic		
	Electronic dimming		
High intensity discharge (HPS & Metal Halide >200W)	Electro magnetic		
	Hybrid		
Mercury	Electro magnetic	Similar to the discharge lamps detailed above, but less widely used.	
Incandescent (tungsten halogen)	Mains	Used in many display and hospitality applications – may be direct mains voltage or low voltage via a transformer.	
	E transformer		
	M transformer		
LED	Electronic	Low energy light source which is available in a range of lamp and luminaire arrangements.	
Induction	Electronic	A form of discharge lighting in which power is induced in the lamp without the need for internal electrodes.	

Table 1: Light Source Descriptions

Lighting Control Type	Description
None	Where no lighting controls are present and the lighting operates continually.
Manual/timer	Where the lighting is manually switched with no automated controls, or is switched off or dimmed at a set time of day using a timer.
Presence/PIR Dimming	Lighting controls which dim lighting based on presence detection i.e. when no presence is detected the lighting dims to a lower energy saving level. Detection may be based on Passive Infrared (PIR) sensors or other sensors.
Presence/PIR on-off	Lighting controls which switch off lighting based on presence detection i.e. when no presence is detected the lighting switches off. Detection may be based on Passive Infrared (PIR) sensors or other sensors.
Presence & daylight dimming	Where both daylight control and presence detection is used to dim lighting. Daylight control uses photocells to determine brightness levels and reduce lighting intensity where possible. Note this measure is attributed a low level of saving reflecting the short duration of daylight hours during the winter peak period.
Presence & daylight on-off	Where both daylight control and presence detection is used to switch off lighting.

Table 2: Lighting Control Descriptions

Technical data and calculation sheet Lighting and Lighting Controls

Deemed Savings Formula & Tables

The formulae below describe the methodology to calculate the Electricity Demand Reduction for lighting systems. For more information please see the guidance notes.

$$EDR_{savings} = kW_{existing} - kW_{proposed} \quad (1)$$

where

$$kW_{existing} = \frac{Quantity_e \times LPL_e \times W_e \times (1 + loss\ factor) \times (1 - controls\ factor)}{1,000} \quad (2)$$

$$kW_{proposed} = \frac{Quantity_p \times LPL_p \times W_p \times (1 + loss\ factor) \times (1 - controls\ factor)}{1,000} \quad (3)$$

Where:

Controls factor = lighting control factor x building control factor

- $Quantity_e$ - The quantity of existing luminaires
- $Quantity_p$ - The quantity of proposed luminaires
- LPL_e - The number of lamps per luminaire in the existing fittings
- LPL_p - The number of lamps or light sources per luminaire in the proposed fitting
- W_e - The wattage of the existing lamps
- W_p - The wattage of the proposed lamps or light-sources
- Loss factor - The associated overhead, ballast loss or LED driver loss applicable to the control of the existing and proposed lamps and light sources. Note this is based on the type of lamp or light source used with losses referenced from the associated tables.
- Controls factor – The level of controls saving applicable based upon the building type, building area and controls type entered. The factors applied are taken from the associated standardised lighting control factor and building control factor tables. The product of the Lighting Control Factor and Building Control Factor is the control factor.

Example calculation

The example below details an Electricity Demand Reduction calculation for a warehouse proposing to upgrade their lighting from metal halide sources to LED technology with improved controls through occupancy detection.

Example

Replacement of 100 400W Metal Halide luminaires in a warehouse. The existing luminaires have a single lamp per fitting, electronic ballasts, manual controls and operate in the main storage area of the warehouse. The proposed system is to utilise 100 150W LED luminaires with automatic presence detection which turn the luminaires off when not required. The warehouse is open from 4-8pm every weekday.

$$kW_{existing} = \frac{100 \times 1 \times 400 \times (1 + 0.15) \times (1 - 0)}{1,000} = 46kW$$

$$kW_{proposed} = \frac{100 \times 1 \times 150 \times (1 + 0.05) \times (1 - (0.9 \times 0.5))}{1,000} = 8.663kW$$

$$EDR_{savings} = kW_{existing} - kW_{proposed} = 46kW - 8.663kW = 37.338kW$$

Deemed Savings Tables

Table 1 details the exiting light ballast and control gear losses used in the calculations.

Light Source		Control Gear	Attributed Loss factor (% of Lamp Wattage)
T12 – Fluorescent		Switch start	0.20
T8 - Fluorescent		Switch start	0.15
		HF standard	0.10
		HF dimming	0.10
T5 - Fluorescent		HF standard	0.05
		HF dimming	0.06
Compact Fluorescent (single ended)		Switch start	0.15
		HF standard	0.10
		HF dimming	0.10
High intensity discharge (High Pressure Sodium & Metal Halide <200W)		Electro magnetic	0.15
		Electronic	0.08
		Electronic dimming	0.10
High intensity discharge (High Pressure Sodium & Metal Halide >200W)		Electro magnetic	0.15
		Hybrid	0.10
Mercury		Electro magnetic	0.15
Incandescent (tungsten halogen)		Mains	0.00
		E transformer	0.075

	M transformer	0.10
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Table 1: Existing light source loss factors

Table 2 details the proposed light ballast and control gear losses used in the calculations

Light Source	Control Gear	Attributed Loss factor (% of Lamp Wattage)
LED	Electronic	0.05
T5 – Fluorescent	HF standard	0.05
	HF dimming	0.06
Induction	Electronic	0.10
Compact Fluorescent (single ended)	HF standard	0.10
	HF dimming	0.10
High intensity discharge (HPS & Metal Halide <200W)	Electronic	0.08
	Electronic dimming	0.10
High intensity discharge (HPS & Metal Halide >200W)	Hybrid	0.12

Table 2: Proposed light sources loss factors

Lighting controls

Table 3 below details the control type factor which is multiplied by the relevant building control factor in Table 4 to give the percentage level of controls saving applicable. This provides a deemed control saving based on the participants’ details.

Controls	Lighting control factor
None	0
Manual/timer	0
Presence/PIR Dimming	0.8
Presence/PIR on-off	0.9
Presence & daylight dimming	0.9
Presence & daylight on-off	0.9

Table 3: Lighting Control Factors**Table 4: Building Control Factors**

Building Type	Area of Building	Building Control Factor
Office	Open Plan	0.20
	Corridor	0.10
	Cellular Offices	0.40
	Meeting Room	0.40
	Break-out/Canteen	0.20
	External	0.00
	Other	0.20
Education	Corridor	0.10
	Classroom	0.20
	Canteen	0.20
	Office	0.40
	Auditorium	0.40
	External	0.00
	Other	0.20
Healthcare	Corridor	0.10
	Waiting	0.40
	Office	0.40
	Ward	0.00
	Treatment Area	0.10
	External	0.00
	Other	0.10
Retail	Main Store	0.10
	Customer Toilets	0.40
	Staff Lounges/Canteens	0.40
	Offices	0.20
	Corridors/ Storage	0.40
	External	0.00

Appendix A: Deemed Measure Overviews and Data Calculations

Building Type	Area of Building	Building Control Factor
	Other	0.20

Building Type	Area of Building	Building Control Factor
Warehousing/Logistics	Main Warehouse	0.50
	Offices	0.20
	Corridors	0.15
	Dispatch	0.20
	Goods Inwards	0.20
	External	0.00
	Other	0.15
Industrial / Manufacturing	Production Areas	0.10
	Offices	0.20
	Corridors	0.20
	Warehousing	0.50
	Canteen/Meeting Rooms	0.40
	External	0.00
	Other	0.20
Hospitality	Reception	0.20
	Corridors	0.10
	Bedrooms	0.00
	Restaurant Areas	0.20
	Staff Areas	0.20
	External	0.00
	Other	0.10
Other	Open Plan	0.20
	Corridor	0.10
	Cellular Offices	0.40
	Meeting Room	0.40
	Storage	0.40
	External	0.00
	Other	0.10

Table 4: Building Control Factors

4. Motors - Single Speed AC Induction, Permanent Magnet Synchronous and Integrated Motor Drive Units

Measure overview

Description

Single Speed AC Induction Motors cover products that are specifically designed to convert electrical power into mechanical power to rotate a drive shaft at a fixed speed that is directly related to the frequency of the electrical power supply. This is by means of a standard three phase AC induction motor. These motors are used to drive plant and machinery throughout industry and commerce. A wide range of 'general purpose' products are available in internationally agreed standard designs with different rated power outputs, frame sizes, fixed operating speeds and energy efficiency ratings.

Permanent Magnet Motors Synchronous Motors are products that are specifically designed to rotate a mechanical drive shaft by converting a multi-phase electrical power input into a rotating magnetic field and applying it to an array of permanent magnets that turn the mechanical drive shaft. These motor drives consist of a permanent magnet synchronous motor and a matched electronic variable speed drive (VSD) that is specifically designed to provide the variable frequency, multiphase electrical power input needed to operate the permanent magnet synchronous motor and to vary its speed in a controlled manner in response to an external signal. These motors are generally more compact and more energy efficient than AC induction motors with the same power rating because they do not require rotor windings.

Integrated Motor Drive Units are a combination of an electronic variable speed drive (VSD) and an AC induction motor. The VSD is physically mounted on the motor, and is specifically designed to drive that particular motor and thus is optimally matched to it. This makes an integrated motor drive unit easier to deploy than purchasing two separate components.

Applicability

- This measure allows for replacement of functional Single Speed AC Induction Motors, Permanent Magnet Synchronous Motors and Integrated Motor Drive Units in industrial, commercial and public applications
- This measure allows for the replacement of different sized motors
- This measure only applies to replacing the same number of motors as already installed
- This measure allows for the calculation to be made with or without the existence of variable speed drives for induction motors
- This measure allows for the addition of a variable speed drive as part of the proposed installation
- This measure also allows for variable speed drives to be fitted to existing motor systems without replacing the motor.
- Replacement motors must be at least IE3 efficiency class to be eligible.

Assumptions

- Degradation in efficiency due to the age of the existing motors has been embedded into the calculations
- Load factors have been deemed by motor size and application (i.e. fans, pumps, compressors) and have been embedded in the calculation
- VSD efficiency loss and harmonic losses have also been embedded in to the calculations

Exclusions

- This measure does not apply to the replacement of failed motors
- This measure does not apply to the installation of new motors in new build/expansion application
- Replacement motors below IE3 efficiency class are not eligible.

Definitions

- Efficiency of Motor – The ratio of usable shaft power to electrical input. This is classified by IEC 60034-30 and currently specifies motor electrical efficiency classes for motors into IE1, IE2, IE3 or IE4
- Power Rating – The maximum input power for the motor given in kW. This is commonly located on the rating plate or otherwise in manufacturer documentation
- Application – Refers to where the motor(s) are being used i.e. Fans, Pumps, and Air Compressors etc.
- Age of Motor – Refers to the date the motor was purchased
- Variable Speed Drive – An electronic power convertor that generates a multiphase variable frequently output that can be used to drive a standard AC induction motor, or permanent magnet synchronous motor in order to modulate speed, torque and mechanical power output
- Rpm/Poles – Motor speed (given in Rpm) and the No. of poles are related and have an effect on the overall efficiency of motors (average used within calculations)

Completing the M&V Plan for Deemed Savings – Motors

There are 4 tabs in the M&V Plan for Deemed Savings Motors & VSD Calculators

- 1) Cover Sheet
- 2) Motor Replacement Unit
- 3) VSD Only Input
- 4) Help

This calculator should be used when you are replacing motors and/or fitting variable speed drives. There are two data entry tabs on this calculator. Which one you should use is described below.

For replacement motors, the existing equipment and proposed equipment should be entered into the “motor replacement input” tab whether or not a VSD is also being installed. Details of the existing and proposed equipment should be entered into adjacent lines on this sheet. Only “one for one” motor replacements are allowed using the deemed saving approach.

You are required to input:

- Site Code
- Motor description and type of motor
- Number of Motors
- The kW rating of the existing and proposed motors
- The approximate age of existing motors
- The application/use of the motor (i.e. pumps, fans)
- The efficiency rating of the new motor (IE number)
- Confirm whether a VSD is already installed or is being installed as part of the proposed installation.
- Peak Applicability

Further details and help on how to source this information is found within the M&V Plan for Deemed Savings – Motors & VSD Calculations

Information to support your Motors & VSD Calculations application

You must provide a copy of the manufacturer brochure, or technical data sheets (or website link to them), detailing the technical specification of each type of motor and/or VSD being installed under this measure.

Technical data and calculation sheet - Motors

Deemed Savings Formula & Tables

$$EDR_{savings} = kW_{ex} - kW_{pr}$$

$$kW_{existing} = Rated\ kW_{ex} \times (FSLF_{ex} \times VSLFM_{ex}) \div ((0.01 \times Efficiency_{ex} - VSHL_{ex}) \times VSD\ EF_{ex})$$

$$kW_{proposed} = Rated\ kW_{ex} \times (FSLF_{ex} \times VSLFM_{pr}) \div ((0.01 \times Efficiency_{pr} - VSHL_{pr}) \times VSD\ EF_{pr}) \quad *$$

Rated kW_{ex} = rated output of existing motor – from rating plate*

Rated kW_{pr} = rated output of existing motor – from supplier documentation

Efficiency_{ex} = Current efficiency of existing motor = **Efficiency_{base}** – **Ageing factor**

Efficiency_{base} = Efficiency of existing motor at time of purchase – as selected using the relevant kW rating from the tables below

Efficiency_{pr} = Efficiency of replacement motor – as selected using the relevant kW rating from the tables below

Ageing factor = Factor to account for efficiency loss – read from tables below

FSLF_{ex} = (Fixed Speed Load Factor) = factor to account for typical loading - read from tables below (always based on Rated kW existing)

VSLFM_{ex} and VSLM_{pr}** (Variable Speed Load Factor Multiplier) = Factor to account for VSD saving - read from tables below (based on rated kW existing or proposed as appropriate)

VSHL_{ex}** = (Variable Speed Harmonic Loss - existing) = $(0.13 \times (100 - Efficiency_{ex}) / 100)$ = factor to account for motor losses when using existing VSD - read from tables below

VSHL_{pr}** = (Variable Speed Harmonic Loss - proposed) = $(0.13 \times (100 - Efficiency_{pr}) / 100)$ = factor to account for motor losses when using VSD for proposed measure - read from tables below

VSD EF_{ex} and VSD EF_{pr}** = VSD Efficiency Factor = factor to account for VSD losses - read from tables below (based on rated kW existing or proposed as appropriate)

*Please note, the rated kW of the *existing* motor (not the proposed motor) is used to calculate the kW of the proposed motor to consistently account for motor loads in any instance where larger motors are replaced by smaller ones. For example, if a 10kW motor with a load factor of 60% is replaced by a 6kW motor the new motor will need to run at 100% load to carry out the same work. By using the kW rating and fixed load factor of the existing motor in the proposed motors calculation this is accounted for.

**Please note, VSLFM, VSHL and VSD EF are only applicable where variable speed driven motors are part of the proposed and/or existing project.

Where no variable speed is present you should use:

VSLFM= 1 VSHL= 0 and VSD EF = 1

Deemed Savings Tables

Base efficiency and aging factor

The base efficiency is determined by the age and size of the motor and where appropriate by applying a degradation factor due to age.

The relevant efficiency class using age as a proxy is shown in the table below. This also shows the adjusted aging factor which should be subtracted from the efficiency value:

Selection of Motor Efficiency and ageing factor				
Age	Efficiency table to use		Aging factor	
	AC single speed induction	Permanent Magnet Synchronous	AC single speed induction	Permanent Magnet Synchronous
<1995	IE1	IE2	2%	2%
1995 – 2000	IE1	IE2	1%	1%
2001 – 2004	IE1	IE2	0.5%	0.5%
2005 – 2010	IE1	IE2	0	0
>2010	IE2	IE3	0	0

For Permanent Magnet Motors the efficiency is assumed to be one class higher to account for enhanced efficiency of the technology (e.g. where a single speed motor from 2005-2010 is assumed to be IE1, a PM motor of the same age is assumed to have an efficiency of IE2)

Efficiency tables

The following table shows the efficiency classes (IE1-IE4) adapted from IEC 60034-34 version 2//1679/CDV. An average of 2, 4, 6 and 8 Pole values is taken (not shown), but with the omission of 8 pole from the calculation for motors below 18.5kW in size due to its relative infrequent occurrence:

	IE1: Nominal Efficiency Limits (%) 50 Hz	IE2: Nominal Efficiency Limits (%) 50 Hz	IE3: Nominal Efficiency Limits (%) 50 Hz	IE4: Nominal Efficiency Limits (%) 50 Hz
Motor kW	Efficiency	Efficiency	Efficiency	Efficiency
0.75	71.40	77.63	80.70	83.97
1.1	74.30	79.70	82.60	85.63
1.5	76.53	81.30	84.00	86.87
2.2	79.03	83.10	85.63	88.30
3	80.90	84.47	86.80	89.37
4	82.53	85.67	87.83	90.20
5.5	84.17	86.90	88.93	91.10
7.5	85.57	88.00	89.87	91.87
11	87.20	89.30	90.97	92.73
15	88.37	90.20	91.73	93.37
18.5	88.83	90.55	91.98	93.48
22	89.45	91.03	92.40	93.80
30	90.38	91.83	93.08	94.33
37	90.95	92.33	93.48	94.65
45	91.50	92.78	93.83	94.90
55	91.95	93.18	94.20	95.23
75	92.63	93.75	94.65	95.55
90	92.95	94.05	94.93	95.75
110	93.28	94.33	95.15	95.95
132	93.50	94.58	95.38	96.13
160	93.80	94.78	95.60	96.30
200	93.95	94.98	95.80	96.45
250	93.95	94.98	95.80	96.50
315	93.95	94.98	95.80	96.53
355	93.95	94.98	95.80	96.53
400	93.95	94.98	95.80	96.53

Fixed Speed Load Factor – FSLF

The following table is used to determine the load factor on a fixed speed motor according to application and motor size (FSLF):

Fixed Speed Load Factors by Application – FSLF						
Rated Power output (kW)	Pumps	Fans	Air Compressor	Refrigeration Compressor	Air Conditioning Compressor	Other
0.75	0.60	0.60	0.60	0.70	0.40	0.60
1.1	0.60	0.60	0.60	0.70	0.40	0.60
1.5	0.60	0.60	0.65	0.70	0.40	0.60
2.2	0.60	0.60	0.65	0.70	0.40	0.60
3	0.60	0.60	0.65	0.70	0.40	0.60
4	0.60	0.60	0.65	0.70	0.45	0.60
5.5	0.60	0.60	0.65	0.70	0.45	0.60
7.5	0.60	0.60	0.65	0.70	0.45	0.60
11	0.60	0.60	0.65	0.75	0.45	0.60
15	0.60	0.60	0.65	0.75	0.45	0.60
18.5	0.60	0.60	0.65	0.75	0.45	0.60
22	0.60	0.60	0.65	0.75	0.45	0.60
30	0.60	0.60	0.65	0.75	0.45	0.60
37	0.60	0.60	0.65	0.75	0.45	0.60
45	0.60	0.60	0.65	0.75	0.45	0.60
55	0.60	0.60	0.65	0.75	0.45	0.60
75	0.65	0.65	0.65	0.80	0.50	0.60
90	0.65	0.65	0.65	0.80	0.50	0.60
110	0.65	0.65	0.65	0.80	0.50	0.60
132	0.65	0.65	0.65	0.80	0.50	0.60
160	0.65	0.65	0.65	0.80	0.50	0.60
200	0.65	0.65	0.65	0.80	0.50	0.60
250	0.65	0.65	0.65	0.80	0.50	0.60
315	0.65	0.65	0.65	0.80	0.50	0.60
355	0.65	0.65	0.65	0.80	0.50	0.60
400	0.65	0.65	0.65	0.80	0.50	0.60

Variable Speed Load Factor Multiplier – VSLFM

The following table is used to determine the load factor multiplier (i.e. proportion saving) when a VSD is fitted according to application and motor size (VSLFM).

Were no VSD is fitted then use VSLFM=1

Variable Speed Load Factor Multiplier by Application – VSLFM						
Rated Power output (kW)	Pumps	Fans	Air Compressor	Refrigeration Compressor	Air Conditioning Compressor	Other
0.75	0.75	0.75	0.90	0.90	0.90	0.90
1.1	0.75	0.75	0.90	0.90	0.90	0.90
1.5	0.75	0.75	0.90	0.90	0.90	0.90
2.2	0.75	0.75	0.90	0.90	0.90	0.90
3	0.75	0.75	0.90	0.90	0.90	0.90
4	0.75	0.75	0.90	0.90	0.90	0.90
5.5	0.75	0.75	0.90	0.90	0.90	0.90
7.5	0.75	0.75	0.90	0.90	0.90	0.90
11	0.75	0.75	0.90	0.90	0.90	0.90
15	0.75	0.75	0.90	0.90	0.90	0.90
18.5	0.75	0.75	0.90	0.90	0.90	0.90
22	0.75	0.75	0.90	0.90	0.90	0.90
30	0.75	0.75	0.90	0.90	0.90	0.90
37	0.75	0.75	0.90	0.90	0.90	0.90
45	0.75	0.75	0.90	0.90	0.90	0.90
55	0.75	0.75	0.90	0.90	0.90	0.90
75	0.75	0.75	0.90	0.90	0.90	0.90
90	0.75	0.75	0.90	0.90	0.90	0.90
110	0.75	0.75	0.90	0.90	0.90	0.90
132	0.75	0.75	0.90	0.90	0.90	0.90
160	0.75	0.75	0.90	0.90	0.90	0.90
200	0.75	0.75	0.90	0.90	0.90	0.90
250	0.75	0.75	0.90	0.90	0.90	0.90
315	0.75	0.75	0.90	0.90	0.90	0.90
355	0.75	0.75	0.90	0.90	0.90	0.90
400	0.75	0.75	0.90	0.90	0.90	0.90

Variable Speed Harmonic Loss (VSHL) and VSD Efficiency Factors (VSD EF)

The following table shows the Variable Speed Harmonic Loss (VSHL) and VSD Efficiency Factors (VSD EF) to use in the formulae according to motor size.

Were no VSD is fitted then use VSHL = 0 and VSD EF=1

VSD Factors		
Motor Size	VSHL	VSD EF
0.75 kW	$0.13 \times (100\% - \text{motor efficiency})/100$	0.90
1.1 kW	$0.13 \times (100\% - \text{motor efficiency})/100$	0.90
1.5 kW	$0.13 \times (100\% - \text{motor efficiency})/100$	0.91
2.2 kW	$0.13 \times (100\% - \text{motor efficiency})/100$	0.92
3 kW	$0.13 \times (100\% - \text{motor efficiency})/100$	0.93
4 kW	$0.13 \times (100\% - \text{motor efficiency})/100$	0.93
5.5 kW	$0.13 \times (100\% - \text{motor efficiency})/100$	0.94
7.5 kW	$0.13 \times (100\% - \text{motor efficiency})/100$	0.94
11 kW	$0.13 \times (100\% - \text{motor efficiency})/100$	0.95
15 kW	$0.13 \times (100\% - \text{motor efficiency})/100$	0.95
18.5 kW	$0.13 \times (100\% - \text{motor efficiency})/100$	0.95
22 kW	$0.13 \times (100\% - \text{motor efficiency})/100$	0.95
>30 kW	$0.13 \times (100\% - \text{motor efficiency})/100$	0.96

Example Calculation

One 75kW fixed speed induction motor installed in 2004 attached to a pump, replaced with a new IE3 55kW and variable speed drive:

$$EDR_{savings} = kW_{ex} - kW_{pr}$$

$$kW_{existing} = Rated\ kW_{ex} \times (FSLF_{ex} \times VSLFM_{ex}) \div ((0.01 \times Efficiency_{ex} - VSHL_{ex}) \times VSD\ EF_{ex})$$

$$kW_{proposed} = Rated\ kW_{ex} \times (FSLF_{ex} \times VSLFM_{pr}) \div ((0.01 \times Efficiency_{pr} - VSHL_{pr}) \times VSD\ EF_{pr})$$

$$VSHL_{pr} = (0.13 \times (100 - Efficiency_{pr}) / 100)$$

Where:

$$Rated\ kW_{ex} = 75kW \quad FSLF_{ex} = 0.65 \quad VSLFM_{pr} = 0.75 \quad VSD\ EF_{pr} = 0.96$$

$$Efficiency_{base} = 92.63 \text{ [use IE1 motor value for 75kW as motor is from 2004]}$$

$$Efficiency_{pr} = 94.20 \text{ [Use IE3 55kW motor value]}$$

$$Efficiency_{ex} = 92.63 - 0.5 = 92.13 \text{ [subtract 0.5% ageing factor as motor is from 2004]}$$

$$VSHL_{pr} = 0.13 \times (100 - 94.20) / 100 = 0.00754$$

Therefore:

$$\begin{aligned} kW_{existing} &= 75kW \times 0.65 \times 1 / [(0.9213 - 0) - 0] \\ &= 52.914 \text{ kW} \end{aligned}$$

$$\begin{aligned} kW_{proposed} &= 75kW \times 0.65 \times 0.75 / [(0.942 - 0.00754) \times 0.96] \\ &= 40.757 \text{ kW} \end{aligned}$$

$$EDR_{savings} = 52.914 - 40.757 = 12.16 \text{ kW}$$

5. Professional Refrigerated Storage Cabinets (PRSCs)

Measure overview

Description

This measure allows for replacement of working Professional Refrigerated Storage Cabinets (PRSC). PRSCs are specifically designed to store but not to display chilled and/or frozen foodstuffs. They are widely used in the catering industry to store frozen or chilled foodstuffs. They are differentiated from Retail Display Cabinets in that a door, lid or drawer must be opened to view and access the contents of the cabinet.

Applicability

- This measure applies to the replacement of one or more currently working PRSCs in one or more premises with more efficient products.
- It applies only to “plug in” products with an integral refrigeration system (i.e. compressor and condensing unit)
- Both current and proposed PRSCs should be of the same basic type i.e. both fridges or both freezers.
- The measure applies to products which are functioning 24 hours per day, 5 or 7 days per week over their entire lifespans.

Exclusions

- The deemed savings approach cannot be used for “remote” PRSCs i.e. those that are connected to a remote refrigeration system i.e. where the condenser and/or compressor are not contained within the unit.
- This measure does not apply to replacement of failed PRSCs.
- This measure does not apply to the installation of PRSCs in new premises or expansion of existing facilities i.e. increasing the number or overall capacity of PRSCs.

Definitions

- The total Energy Consumption (TEC) is sum of the Direct Energy Consumption (DEC) and Refrigeration Electrical Energy Consumption (REC). The former is the energy consumption of electrical components of the cabinet and the latter is that of the refrigeration system necessary to operate the cabinet.
- Gross internal volume is the volume within the inside walls of the cabinet without internal fittings, doors or lids if any being closed, as defined in BS EN ISO 441.
- Net volume (as defined in BS EN 441-1: 1995) is the volume that can contain food products within the load limit. The volume of parts necessary for the proper functioning of the cabinet, including shelves, is deducted from the gross volume to determine the net volume.

Completing the M&V Plan for Deemed Savings – Professional Refrigerated Storage Cabinets

There are 4 tabs in the M&V Plan for Deemed Savings Motors & VSD Calculators

- 1) Cover Sheet
- 2) Existing Units
- 3) Proposed Units
- 4) Help

There are two separate data input tabs, one for the existing equipment and one for the proposed. On the existing units tab you should fill out one line for every different unit, or group of identical units being replaced. On the proposed units tab you should fill out one line for every different replacement unit (or group of identical units).

You may use a different number of rows on each sheet e.g. if the number of units in the proposed solution is different to the existing set-up. However the total capacity of the replacement units must be equal to or greater than the existing units. You are required to input:

- Site Code
- Description and quantity of units
- The temperature classification (chilled or frozen)
- Approximate age range of the existing units
- kW rating of the existing and the proposed
- The Total Energy Consumption (TEC) of the proposed unit (from manufacturer quotation or data sheets)
- For RDCs: The TEC or Total Display Area (TDA) of the existing unit.
- For PRSCs: The TEC or gross volume (in litres) of the existing unit
- The geometry (vertical/horizontal) of the units.
- Peak Applicability

Further details and help on how to source this information is found within the M&V Plan for Deemed Savings – PRSCs

Information to support your Professional Refrigerated Storage Cabinets

You must provide a copy of the manufacturer brochure or technical data sheets (or website link to them) including the TEC of each type of proposed equipment should be provided.

Technical data and calculation sheet

Deemed Savings Formula & Tables

$$EDR_{savings} = kW_{existing} - kW_{proposed} \tag{1}$$

$$\text{where } kW_{existing} = \frac{TEC_{existing}}{24} \times (100\% + \text{age factor}) \tag{2}$$

$$\text{where } kW_{proposed} = \frac{TEC_{proposed}}{24} \tag{3}$$

TEC (the Total Energy Consumption over 24 hours) is either obtained from manufacturers' data sheet where possible or (for existing units where TEC is not available) using equations (4) to (8):

$$TEC_{Vertical MT} = 0.0041 \times \text{net volume} + 1.5026 \tag{4}$$

$$\begin{aligned} TEC_{Horizontal MT} \\ = 0.0063 \times \text{net volume} + 4.4145 \end{aligned} \tag{5}$$

$$TEC_{Vertical LT} = 0.0122 \times \text{net volume} + 3.6294 \tag{6}$$

$$\begin{aligned} TEC_{Horizontal LT} \\ = 0.0144 \times \text{net volume} + 5.868 \end{aligned} \tag{7}$$

$$\text{Net volume} = \text{Gross volume} \times 77\% \tag{8}$$

MT = Medium temperature i.e. chillers

LT = Low temperature i.e. freezers

Vertical/Horizontal refer to the geometry of the cabinet

Gross volume is the total volume within the inside walls of the cabinet or compartment without internal fittings, doors or lids if any being closed, and is defined in BS EN ISO 441.

Net volume (as defined in BS EN 441-1: 1995) is the volume that can contain food products within the load limit. The volume of parts necessary for the proper functioning of the cabinet, including shelves, is deducted from the gross volume to determine the net volume.

Ageing factor

Age of the unit	Aging factor
0 to 5	0%

5 to 10	5%
more than 10	8%

Example calculation

Replacement of 100 PRSCs vertical chiller aged 7 years (Gross volume= 600 litres) with 100 new vertical chiller PRSCs alternatives (unitary TEC=2.5 Kwh/day). As per equations (1) to (8), the calculations will be as follows:

	Existing units	Proposed units
Calculate TEC	$TEC=(0.0041 \times 600 \times 77\% + 1.5026)$	
Calculate kW demand	$kW = \frac{(0.0041 \times 600 \times 77\% + 1.5026)}{24} = 0.14$	$kW = \frac{2.5}{24} = 0.1042$
Factor in age	$= 0.14 \times (100\% + 5\%) = 0.1486$	
Multiply by number of units	$= 0.14 \times 100 = 14.86$	$= 0.1042 \times 100 = 10.42$
Total	$kW_{existing} = 14.86$	$kW_{proposed} = 10.42$
Step 6	Peak kW savings = $14.86 - 10.42 = 4.44$ kW	

Calculating gross volume

Gross volume (in litre) = (height (in metre) × width (in metre) × depth (in metre)) × 1,000

6. Refrigerated Display Cabinets (RDCs)

Measure overview

Description

This measure allows for replacement of working Refrigerated Display Cabinets (RDCs). RDCs are specifically designed to store and display chilled and/or frozen foodstuffs and beverages. There are many different designs, but all enable the customer to view the foodstuff stored in the cabinet, either through an opening in the cabinet, or through a transparent door or lid. The measure only covers 'Plug in' RDCs with an integral refrigeration system (i.e. incorporating a compressor and condensing unit inside the cabinet).

Target Market Segments

Commercial, Industrial, Public, Not for profit

Target End Uses

Preservation, display and sale of chilled or frozen foodstuff.

Applicability

- This measure applies to the replacement of one or more currently working RDCs in one or more premises with more efficient products. They must enable the customer to view the foodstuff stored in the cabinet, either through an opening in the cabinet, or through a transparent door or lid.
- Both current and proposed RDCs should be of the same basic type and function (e.g replacing a freezer with a freezer)
- The measure applies to products which are functioning 24 hours per day, 5 or 7 days per week over their entire lifespans.

Exclusions

- The deemed savings approach cannot be used for "Remote" RDCs, designed to work with a non-integral refrigeration system (i.e. where the compressor and/or condensing unit are located at a different location to the cabinet).
- This measure does not apply to replacement of failed RDCs.
- This measure does not apply to the installation of RDCs in new premises or expansion of existing facilities i.e. increasing the number or overall capacity of RDCs.

Definitions

- The total Energy Consumption (TEC) is sum of the Direct Energy Consumption (DEC) and Refrigeration Electrical Energy Consumption (REC). The former is the energy consumption of electrical components of the cabinet and the latter is that of the refrigeration system necessary to operate the cabinet.
- The Total Display Area (TDA) is the total visible foodstuffs area, including visible area through the glazing, defined by the sum of horizontal and vertical projected surface areas of the net volume, as defined in Annex A BS EN ISO 23953

- For the avoidance of doubt, only standardised geometries/configurations of RDCs are included into the scheme. These are illustrated in the table below:

	Vertical	Horizontal
Geometry	Vertical RDCs include tall, open units used for displaying produce and dairy. Tall fridge and freezer units with glass doors are also considered to be vertical RDCs.	Horizontal RDCs include typical delicatessen-style display counters and deep well reach-in freezers.
Picture		

Completing the M&V Plan for Deemed Savings – Refrigerated Display Cabinets (RDCs)

There are 4 tabs in the M&V Plan for Deemed Savings Refrigerated Display Cabinets (RDCs)

- 1) Cover Sheet
- 2) Existing Units
- 3) Proposed Units
- 4) Help

There are two separate data input tabs, one for the existing equipment and one for the proposed. On the existing units tab you should fill out one line for every different unit, or group of identical units being replaced. On the proposed units tab you should fill out one line for every different replacement unit (or group of identical units).

You may use a different number of rows on each sheet e.g. if the number of units in the proposed solution is different to the existing set-up. However the total capacity of the replacement units must be equal to or greater than the existing units. You are required to input:

- Site Code
- Description and quantity of units
- The temperature classification (chilled or frozen)
- Approximate age range of the existing units
- kW rating of the existing and the proposed
- The Total Energy Consumption (TEC) of the proposed unit (from manufacturer quotation or data sheets)
- For RDCs: The TEC or Total Display Area (TDA) of the existing unit.
- For PRSCs: The TEC or gross volume (in litres) of the existing unit
- The geometry (vertical/horizontal) of the units.
- Peak Applicability

Further details and help on how to source this information is found within the M&V Plan for Deemed Savings – RDCs

Information to support your Professional Refrigerated Storage Cabinets

You must provide a copy of the manufacturer brochure or technical data sheets, or website link to them, including the TEC of each type of proposed equipment should be provided.

Technical data and calculation sheet

Deemed Savings Formula & Tables

$$EDR_{savings} = kW_{existing} - kW_{proposed} \tag{1}$$

$$where\ kW_{existing}(rating) = \frac{TEC}{24} \times (100\% + ageing\ factor) \tag{2}$$

$$where\ kW_{proposed}(rating) = \frac{TEC}{24} \tag{3}$$

TEC (the Total Energy Consumption over 24 hours) is either obtained from manufacturers’ data sheet or using equations (4) or (5):

$$TEC\ (chilled\ RDC) = 9.8053 \times TDA \times (100\% + configuration\ factor) \tag{4}$$

$$TEC\ (frozen\ RDC) = 16.263 \times TDA \times (100\% + configuration\ factor) \tag{5}$$

TDA is Total Display Area. It is either obtained from manufacturer data sheet or calculated in compliance with BS EN ISO 23953 and expressed in square metres.

Configuration factor

Geometry+ temperature range	Configuration factor
Vertical chiller	43%
Horizontal chiller	-43%
Vertical frozen	61%
Horizontal frozen	-61%

Ageing factor

Age of the unit	Aging factor
0 to 5	0%

5 to 10	5%
more than 10	8%

Example calculation

Replacement of 10 vertical chiller RDC aged 7 years (TDA=3 m²) with 10 new and efficient RDC alternative (TEC=30 Kwh/day*m²). As per equations (1) to (5), the calculations will be as follows:

	Existing RDC	Proposed RDC
Calculate TEC	$TEC = \frac{9.8053 \times 3}{24} = 1.22$	$kW_{proposed} = \frac{30}{24} = 1.25$
Factor in age	$\frac{9.8053 \times 3}{24} \times (100\% + 5\%) = 1.29$	
Factor in configuration	$\frac{9.8053 \times 3}{24} \times (100\% + 5\%) \times (100 + 43\%) = 1.84$	
Total kW	$kW_{existing} = 1.84$	$kW_{proposed} = 1.25$
Total for 100 units	$kW_{existing} = 1.84 * 10 = 18.4$	$kW_{proposed} = 1.25 * 10 = 12.5$

Peak kW savings = 18.4-12.5 = 5.9 kW

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Department of Energy & Climate Change
3 Whitehall Place
London SW1A 2AW
www.gov.uk/decc
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