iSERV Measured Data Analysis by HVAC Component and Activity - BELGIUM

By

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Project websites:

Main website: http://www.iservcmb.info
Database website: http://www.iservcmb.eu

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1   Introduction

This report presents the measured HVAC component and end use activity data obtained for Belgium during the iSERV project. This particular report presents the recorded energy use information by floor area and HVAC components for each activity type within the iSERV system.

A separate report presents the energy use information by the floor area served only. The reports have been separated for reasons of size and clarity, as well as due to the more controversial nature of the initial benchmarks used for apportionment by activity, as reported in this document.

2   Overall HVAC Component and Activities Overview plus Data Summaries

This section covers the overall description of the HVAC components as given in the iSERV spreadsheets for Belgium as well as summarising the measured data from the more detailed parts of this report.

Table 1a - Number of meters serving each activity

Activity type	Electricity	Heat
Catering: Full Kitchen Preparing Hot Meals	4	
Cellular Office Area	5	
Cellular Office Area - multiple occupation	7	2
Circulation area (corridors and stairways)	3	
IT: High Density IT Suite	4	
IT: Server Room	4	
Laboratory	3	
Laboratory with fume cupboards	5	
Library - stacks and storeroom	3	
Light Plant Room	4	
Meeting Room	4	
Multi-storey car parks (office and private use)	2	
Open Plan Office Area	4	
Reception	6	
Toilet	7	
Unoccupied space	4	

2.1   Overall HVAC Components and Activities Summary

Table 1b summarises the data collected for the HVAC Components and the iSERV Activity types available in Belgium. It can be seen that the HVAC components in this country service six total activity types with areas ranging in size from 120 to 13600 m^2. There was an average of 4 meters available for each system analysed.

The most frequently encountered component type in this country was pumps.

Table 1b – Overall Systems Summary for Belgium showing numbers of components and meters associated with each activity type. For the components columns, the first number shows total components associated with each activity. The number after the comma shows the number of submeters associated with this component type.

Activity type	Floor Area m2	Num Spaces	Air Handling Units	All in One Systems	Cold Generators	Flow Control	Heat Generators	Heat Pump	Heat Recovery	Heat Rejection	Humidifiers	Pumps	Terminal Units
Catering: Full Kitchen Preparing Hot Meals	1685	2	15		4		8		3	2		42	5
Cellular Office Area	11784	2	22		3	1	5	2		2		37	9
Cellular Office Area - multiple occupation	5773	5	14		3	1	4	1		3	3	51	7
Circulation area (corridors and stairways)	613.3	1	4		1		1			1	3	18	1
IT: High Density IT Suite	210	3	1	2	3		6		3	3		33	1
IT: Server Room	222	2	1	1	6					5		6	3
Laboratory	312.5	1	4		1		1			1	3	18	1
Laboratory with fume cupboards	344	3	4		3		1			3	3	18	1
Library - stacks and storeroom	201	1	4		1		1			1	3	18	1
Light Plant Room	120	1	1		3		6		3	2		31	
Meeting Room	980	1	1		3		6		3	2		31	
Multi-storey car parks (office and private use)	2534	1	9		2	1	3			2		21	3
Open Plan Office Area	13600	4	5		3		6		3	2		60	
Reception	1697	3	24		6	1	11		3	4		74	8
Toilet	2616	2	9		4		7		3	3	3	52	1
Unoccupied space	2930	1	1		3		6		3	2		33	

2.2 Summary by Activity type of measured Electrical Power Demands

This summary section contains 9 tables, one for each activity type for which we have data, summarising the range of electrical power demands found across all the HVAC sub-component types monitored in iSERV.

The main observations from all these tables are:

- Only 8 activities had measured data
- These activities had a sufficient number of metered samples to obtain reasonably accurate benchmarks from.

A summary of the average **maximum** power demand benchmarks is shown in Table 2. Values in brackets indicate the standard deviation found from this average maximum. This data can be used to estimate the likely power demand to be to be incurred by the HVAC component while servicing this type of activity in this country. The more detailed tables also show the annual average and minimum power demands found for this equipment. Zero figures are excluded from the minima i.e. the minima show how little power might be drawn by energised equipment.

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The first column shows the section number in which these benchmarks can be found. Benchmarks in red are considered to have too few samples or too short a measurement period to be reliable.

Table 2 – Benchmarks for measured Average and Standard Deviation Power Demands in W/m² Summary by HVAC Component and Activity Type for Belgium.

Activity type	Meter type	Sample size	Air handling Units	All in one systems	Cold generators	Heat Pump	Heat rejection	Pumps
Cellular Office Area	Electricity	2				0.12 (0)		0.368 (0.0533)
Cellular Office Area - multiple occupation	Electricity	3			5.25		0.0762	0.138 (0.0252)
Circulation area (corridors and stairways)	Electricity	1			3.54		0.0490	0.145 (0.0265)
IT: Server Room	Electricity	1	32.2	49.5	46.2 (3.37)		0.727 (0.570)	0.952 (0)
Laboratory	Electricity	1			9.35		0.105	0.408 (0.0747)
Laboratory with fume cupboards	Electricity	3			12.7 (6.77)		0.272 (0.209)	0.408 (0.0746)
Library - stacks and storeroom	Electricity	1			1.24		0.150	0.0548 (0.010)
Toilet	Electricity	4			0.842		0.0876	0.168 (0.0308)

Figure 1: Measured Overall Power Demand in W/m2 by HVAC Component type. Summary for Belgium

Measured Overall Power Demand in W/m² Summary for Belgium
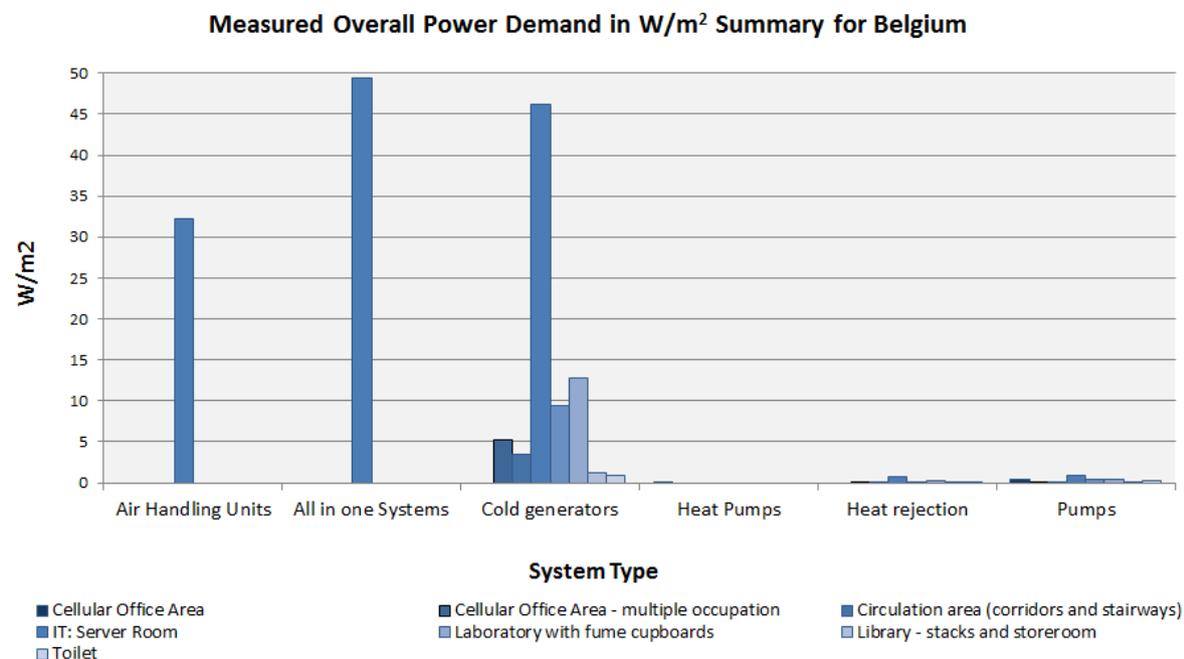
2.2.1 Circulation area (corridors and stairways) – power demand summary by component

The table shows the average, maximum and minimum power demands found from the data for this activity type for the overall component type shown in each column. The breakdown of these component types into the power demand ranges found for each subcomponent type are given in section **Error! Reference source not found.**.

Table 3 – Measured Overall Power Demands in W/m² Summary by HVAC Component Type for Circulation area (corridors and stairways) for Belgium

Parameter	Cold Generators		Heat rejection		Pumps	
Sample size (number)	1		1		8	
Average (Standard Deviation)	3.54	(0.00)	0.05	(0.00)	0.15	(0.03)
Maximum (Standard Deviation)	11.81	(0.00)	0.15	(0.00)	0.44	(0.08)
Minimum (Standard Deviation)	0.15	(0.00)	0.00	(0.00)	0.00	(0.00)

2.2.2 Cellular office area – power demand summary by component

The table shows the average, maximum and minimum power demands found from the data for this activity type for the overall component type shown in each column. The breakdown of these component types into the power demand ranges found for each subcomponent type are given in section **Error! Reference source not found.**.

Parameter	Heat Pumps		Pumps	
Sample size (number)	2		2	
Average (Standard Deviation)	0.12	(0.00)	0.37	(0.05)
Maximum (Standard Deviation)	1.34	(0.00)	0.38	(0.07)
Minimum (Standard Deviation)	0.01	(0.00)	0.06	(0.04)

2.2.3 Cellular office area (multiple occupation) – power demand summary by component

The table shows the average, maximum and minimum power demands found from the data for this activity type for the overall component type shown in each column. The breakdown of these component types into the power demand ranges found for each subcomponent type are given in section **Error! Reference source not found.**.

Parameter	Cold Generators		Heat rejection		Pumps	
Sample size (number)	1		1		8	
Average (Standard Deviation)	5.25	(0.00)	0.08	(0.00)	0.14	(0.03)
Maximum (Standard Deviation)	17.57	(0.00)	0.23	(0.00)	0.42	(0.08)
Minimum (Standard Deviation)	0.22	(0.00)	0.00	(0.00)	0.00	(0.00)

2.2.4 IT server room – power demand summary by component

The table shows the average, maximum and minimum power demands found from the data for this activity type for the overall component type shown in each column. The breakdown of these component types into the power demand ranges found for each subcomponent type are given in section **Error! Reference source not found.**.

Parameter	Air Handling Units		All-in-One Systems		Cold generators		Heat rejection		Pumps	
Sample size (number)	1		1		4		2		4	
Average (Standard Deviation)	32.16	(0.00)	49.47	(0.00)	46.17	(3.37)	0.73	(0.57)	0.95	(0.00)
Maximum (Standard Deviation)	80.22	(0.00)	123.41	(0.00)	77.07	(10.80)	1.21	(1.04)	1.64	(0.00)
Minimum (Standard Deviation)	7.33	(0.00)	11.28	(0.00)	22.93	(5.00)	0.36	(0.17)	0.41	(0.00)

2.2.5 Laboratory – power demand summary by component

The table shows the average, maximum and minimum power demands found from the data for this activity type for the overall component type shown in each column. The breakdown of these component types into the power demand ranges found for each subcomponent type are given in section **Error! Reference source not found.**.

Parameter	Cold Generators		Heat rejection		Pumps	
Sample size (number)	1		1		8	
Average (Standard Deviation)	9.35	(0.00)	0.11	(0.00)	0.41	(0.07)
Maximum (Standard Deviation)	31.23	(0.00)	0.32	(0.00)	1.25	(0.23)
Minimum (Standard Deviation)	0.39	(0.00)	0.00	(0.00)	0.01	(0.00)

2.2.6 Laboratory with fume cupboards – power demand summary by component

The table shows the average, maximum and minimum power demands found from the data for this activity type for the overall component type shown in each column. The breakdown of these component types into the power demand ranges found for each subcomponent type are given in section **Error! Reference source not found.**.

Parameter	Cold Generators		Heat rejection		Pumps	
Sample size (number)	3		3		8	
Average (Standard Deviation)	12.70	(6.77)	0.27	(0.21)	0.41	(0.07)
Maximum (Standard Deviation)	672.43	(1114.67)	16.46	(27.67)	1.25	(0.23)
Minimum (Standard Deviation)	3.80	(5.13)	0.09	(0.13)	0.01	(0.00)

2.2.7 Library - stacks and storeroom – power demand summary by component

The table shows the average, maximum and minimum power demands found from the data for this activity type for the overall component type shown in each column. The breakdown of these component types into the power demand ranges found for each subcomponent type are given in section **Error! Reference source not found.**.

Parameter	Cold Generators		Heat rejection		Pumps	
Sample size (number)	1		1		8	
Average (Standard Deviation)	1.24	(0.00)	0.15	(0.00)	0.05	(0.01)
Maximum (Standard Deviation)	4.15	(0.00)	0.46	(0.00)	0.17	(0.03)
Minimum (Standard Deviation)	0.05	(0.00)	0.01	(0.00)	0.00	(0.00)

2.2.8 Toilet – power demand summary by component

The table shows the average, maximum and minimum power demands found from the data for this activity type for the overall component type shown in each column. The breakdown of these component types into the power demand ranges found for each subcomponent type are given in section **Error! Reference source not found.**.

Parameter	Cold Generators		Heat rejection		Pumps	
Sample size (number)	1		1		8	
Average (Standard Deviation)	0.84	(0.00)	0.09	(0.00)	0.17	(0.03)
Maximum (Standard Deviation)	2.80	(0.00)	0.27	(0.00)	0.51	(0.09)
Minimum (Standard Deviation)	0.03	(0.00)	0.00	(0.00)	0.01	(0.00)

2.3 Summary of measured annual energy use by HVAC Component type servicing a given activity

This summary section contains tables for each activity type for which we have data, summarising the range of electrical annual energy consumption per m² found across all the HVAC sub-component types monitored in iSERV.

A summary of the measured average annual energy use benchmarks by activity type and HVAC component type is shown in Table 4. Values in brackets indicate the standard deviation found from this average. This data can be used to estimate the likely annual energy use range to be incurred by the HVAC component while servicing this type of activity in this country. The more detailed tables also show the annual maximum and minimum annual energy use ranges found for this equipment.

Table 4 – Benchmarks for measured Average and Standard Deviation Annual Energy Use in kWh/m2 Summary by HVAC Component and Activity Type for Belgium.

Activity type	Meter Type	Heat Generators		Cold Generators		All-in-One Systems		Heat Pumps		Air Handling Units	
Cellular Office Area - multiple occupation	Electricity	4.88	(3.25)	9.52	(0.00)	0.31	(0.00)	0.62	(0.00)	6.97	(0.00)
Circulation area (corridors and stairways)	Electricity	1.86	(1.24)	6.27	(0.00)	0.19	(0.00)	0.62	(0.00)	6.97	(0.00)
IT: Server Room	Electricity	0.00	(0.00)	525.09	(0.00)	4.13	(0.00)	0.00	(0.00)	0.00	(0.00)
Laboratory	Electricity	15.21	(10.14)	16.52	(0.00)	0.41	(0.00)	1.73	(0.00)	6.97	(0.00)
Laboratory with fume cupboards	Electricity	15.21	(10.14)	16.52	(0.00)	0.41	(0.00)	1.73	(0.00)	6.97	(0.00)
Library - stacks and storeroom	Electricity	4.89	(3.26)	2.22	(0.00)	0.60	(0.00)	0.24	(0.00)	6.97	(0.00)
Toilet	Electricity	3.02	(2.01)	1.39	(0.00)	0.30	(0.00)	0.62	(0.00)	6.97	(0.00)

2.3.1 Activity types – annual energy use/m² summary by Air-Handling Units sub-components

The table shows the average and standard deviation annual energy use found from the data for all activity types for the Air-Handling Units sub-component type shown in each column. These figures include directly measured energy use and energy use apportioned by initial benchmarks from metered data serving more than one component.

Table 5 – Overall Data Summary by Air-Handling Units Sub-component types. Average and Standard Deviation Annual kWh/m² in Belgium

Activity type	Extract only		Supply only	
Cellular Office Area - multiple occupation	9.75	(0.00)	3.25	(0.00)
Circulation area (corridors and stairways)	3.72	(0.00)	1.24	(0.00)
Laboratory	30.41	(0.00)	10.14	(0.00)
Laboratory with fume cupboards	30.41	(0.00)	10.14	(0.00)
Library - stacks and storeroom	9.77	(0.00)	3.26	(0.00)
Toilet	6.04	(0.00)	2.01	(0.00)

2.3.2 Activity types – annual energy use/m² summary by Cold Generators sub-components

The table shows the average and standard deviation annual energy use found from the data for all activity types for the Cold Generators sub-component type shown in each column. These figures include directly measured energy use and energy use apportioned by initial benchmarks from metered data serving more than one component.

Table 6 – Overall Data Summary by Cold Generators Sub-component types. Average and Standard Deviation Annual kWh/m² in Belgium

Activity type	Direct evaporative cooler		Reciprocating Liquid Chillers	
Cellular Office Area - multiple occupation	0.00	(0.00)	9.52	(0.00)
Circulation area (corridors and stairways)	0.00	(0.00)	6.27	(0.00)
IT: server room	525.09	(0.00)	0.00	(0.00)
Laboratory	0.00	(0.00)	16.52	(0.00)
Laboratory with fume cupboards	16.52	(0.00)	16.52	(0.00)
Library - stacks and storeroom	0.00	(0.00)	2.22	(0.00)
Toilet	0.00	(0.00)	1.39	(0.00)

2.3.3 Activity types – annual energy use/m² summary by Heat rejection sub-components

The table shows the average and standard deviation annual energy use found from the data for all activity types for the Heat rejection sub-component type shown in each column. These figures include directly measured energy use and energy use apportioned by initial benchmarks from metered data serving more than one component.

Table 7 – Overall Data Summary by Heat rejection Sub-component types. Average and Standard Deviation Annual kWh/m² in Belgium

Activity type	Forced air condensers		Mechanical Draft Towers	
Cellular Office Area - multiple occupation	0.00	(0.00)	0.31	(0.00)
Circulation area (corridors and stairways)	0.00	(0.00)	0.19	(0.00)
IT: server room	4.13	(0.00)	0.00	(0.00)
Laboratory	0.00	(0.00)	0.41	(0.00)
Laboratory with fume cupboards	0.41	(0.00)	0.41	(0.00)
Library - stacks and storeroom	0.00	(0.00)	0.60	(0.00)
Toilet	0.00	(0.00)	0.30	(0.00)

2.3.4 Activity types – annual energy use/m² summary by Pumps sub-components

The table shows the average and standard deviation annual energy use found from the data for all activity types for the Pumps sub-component type shown in each column. These figures include directly measured energy use and energy use apportioned by initial benchmarks from metered data serving more than one component.

Table 8 – Overall Data Summary by Pumps Sub-component types. Average and Standard Deviation Annual kWh/m² in Belgium

Activity type	Chilled water primary pumps		Chilled water secondary pumps		Hot water primary pumps		Hot water secondary pumps	
Cellular Office Area - multiple occupation	0.56	(0.00)	0.65	(0.00)	1.24	(0.00)	0.41	(0.00)
Circulation area (corridors and stairways)	0.56	(0.00)	0.65	(0.00)	1.24	(0.00)	0.41	(0.00)
Laboratory	1.56	(0.00)	1.82	(0.00)	3.46	(0.00)	1.15	(0.00)
Laboratory with fume cupboards	1.56	(0.00)	1.82	(0.00)	3.46	(0.00)	1.15	(0.00)
Library - stacks and storeroom	0.21	(0.00)	0.25	(0.00)	0.47	(0.00)	0.16	(0.00)
Toilet	0.56	(0.00)	0.65	(0.00)	1.24	(0.00)	0.41	(0.00)

2.3.5 Activity types – annual energy use/m² summary by Terminal Units sub-components

The table shows the average and standard deviation annual energy use found from the data for all activity types for the Terminal Units sub-component type shown in each column. These figures include directly measured energy use and energy use apportioned by initial benchmarks from metered data serving more than one component.

Table 9 – Overall Data Summary by Terminal Units Sub-component types. Average and Standard Deviation Annual kWh/m² in Belgium

Activity type	Fan Coils – 2 or 4 tubes
Cellular Office Area - multiple occupation	6.97 (0.00)
Circulation area (corridors and stairways)	6.97 (0.00)
Laboratory	6.97 (0.00)
Laboratory with fume cupboards	6.97 (0.00)
Library - stacks and storeroom	6.97 (0.00)
Toilet	6.97 (0.00)

2.4 Summary of measured monthly energy use by HVAC component type servicing a given activity

The tables in this section provide the ranges of average and standard deviation monthly energy consumptions found in different HVAC component types servicing the noted end use activity across Belgium. Whilst this data has the same caveats as for the annual data, what it does illustrate is how the consumption of each sub-component varies with the month of the year.

2.4.1 Activity types – monthly energy use/m² summary by Air-Handling Units component

This table shows the measured ranges of monthly energy use recorded for this component type.

Table 10 – Measured average monthly energy consumption and standard deviation in kWh/m² by Air-Handling Units components servicing the given activity for Belgium

Activity type	ANNUAL TOTAL	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCOTBER	NOVEMBER	DECEMBER
Cellular Office Area - multiple occupation	13.52 (0.46)	1.35 (0.00)	1.33 (0.00)	1.42 (0.00)	0.86 (0.00)	0.85 (0.00)	0.80 (0.00)	0.92 (0.00)	1.08 (0.25)	1.09 (0.28)	1.15 (0.20)	1.21 (0.00)	1.48 (0.00)
Circulation area (corridors and stairways)	5.15 (0.18)	0.51 (0.00)	0.51 (0.00)	0.54 (0.00)	0.33 (0.00)	0.32 (0.00)	0.31 (0.00)	0.35 (0.00)	0.41 (0.09)	0.42 (0.11)	0.44 (0.07)	0.46 (0.00)	0.57 (0.00)
IT: Server Room	0.00 (0.00)	23.58 (0.00)	16.58 (0.00)	10.36 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	25.26 (0.00)	29.72 (0.00)	33.41 (0.00)	20.02 (0.00)	24.45 (0.00)
Laboratory	42.17 (1.44)	4.20 (0.00)	4.14 (0.00)	4.44 (0.00)	2.67 (0.00)	2.66 (0.00)	2.50 (0.00)	2.88 (0.00)	3.37 (0.77)	3.41 (0.86)	3.57 (0.61)	3.77 (0.00)	4.63 (0.00)
Laboratory with fume cupboards	42.17 (1.44)	4.20 (0.00)	4.14 (0.00)	4.44 (0.00)	2.67 (0.00)	2.66 (0.00)	2.50 (0.00)	2.88 (0.00)	3.37 (0.77)	3.41 (0.86)	3.57 (0.61)	3.77 (0.00)	4.63 (0.00)
Library - stacks and storeroom	13.55 (0.46)	1.35 (0.00)	1.33 (0.00)	1.43 (0.00)	0.86 (0.00)	0.85 (0.00)	0.80 (0.00)	0.93 (0.00)	1.08 (0.25)	1.09 (0.28)	1.15 (0.20)	1.21 (0.00)	1.49 (0.00)
Toilet	8.37 (0.29)	0.83 (0.00)	0.82 (0.00)	0.88 (0.00)	0.53 (0.00)	0.53 (0.00)	0.50 (0.00)	0.57 (0.00)	0.67 (0.15)	0.68 (0.17)	0.71 (0.12)	0.75 (0.00)	0.92 (0.00)

2.4.2 Activity types – monthly energy use/m² summary by All-in-One Systems

This table shows the measured ranges of monthly energy use recorded for this component type.

Table 11 – Measured average monthly energy consumption and standard deviation in kWh/m² by All-in-One Systems components servicing the given activity for Belgium

Activity type	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCOTBER	NOVEMBER	DECEMBER
IT: server room	36.28 (0.00)	25.50 (0.00)	15.93 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	38.86 (0.00)	45.72 (0.00)	51.40 (0.00)	30.79 (0.00)	37.62 (0.00)

2.4.3 Activity types – monthly energy use/m² summary by Cold Generators

This table shows the measured ranges of monthly energy use recorded for this component type.

Table 12 – Measured average monthly energy consumption and standard deviation in kWh/m² by Cold Generators components servicing the given activity for Belgium

Activity type	ANNUAL TOTAL	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCOTBER	NOVEMBER	DECEMBER
Cellular Office Area - multiple occupation	9.90 (0.35)	0.99 (0.00)	0.97 (0.00)	1.04 (0.00)	0.63 (0.00)	0.62 (0.00)	0.75 (0.16)	1.78 (0.99)	1.54 (0.65)	0.98 (0.55)	0.71 (0.18)	0.89 (0.00)	1.09 (0.00)
Circulation area (corridors and stairways)	6.52 (0.23)	0.65 (0.00)	0.64 (0.00)	0.69 (0.00)	0.41 (0.00)	0.41 (0.00)	0.50 (0.11)	1.19 (0.66)	1.04 (0.44)	0.66 (0.36)	0.47 (0.11)	0.58 (0.00)	0.72 (0.00)
IT: Server Room	546.07 (19.07)	82.31 (0.00)	80.74 (0.00)	95.74 (0.00)	31.73 (3.99)	33.40 (1.43)	32.57 (0.29)	35.01 (3.25)	83.59 (10.81)	80.42 (12.85)	83.65 (12.57)	76.27 (0.00)	87.55 (0.00)
Laboratory	17.18 (0.60)	1.71 (0.00)	1.69 (0.00)	1.81 (0.00)	1.09 (0.00)	1.08 (0.00)	1.33 (0.28)	3.16 (1.76)	2.74 (1.15)	1.74 (0.96)	1.25 (0.30)	1.54 (0.00)	1.89 (0.00)
Laboratory with fume cupboards	34.37 (1.16)	3.42 (0.00)	3.37 (0.00)	3.62 (0.00)	4.16 (3.00)	3.87 (2.30)	4.54 (2.96)	7.27 (5.15)	6.04 (4.14)	4.21 (2.81)	3.49 (1.70)	3.08 (0.00)	3.77 (0.00)
Library - stacks and storeroom	2.30 (0.08)	0.23 (0.00)	0.23 (0.00)	0.24 (0.00)	0.15 (0.00)	0.15 (0.00)	0.18 (0.04)	0.42 (0.23)	0.36 (0.15)	0.23 (0.13)	0.17 (0.04)	0.21 (0.00)	0.25 (0.00)
Toilet	1.45 (0.05)	0.14 (0.00)	0.14 (0.00)	0.15 (0.00)	0.09 (0.00)	0.09 (0.00)	0.12 (0.03)	0.28 (0.16)	0.24 (0.11)	0.15 (0.08)	0.11 (0.02)	0.13 (0.00)	0.16 (0.00)

2.4.4 Activity types – monthly energy use/m² summary by Heat Pumps

This table shows the measured ranges of monthly energy use recorded for this component type.

Table 13 – Measured average monthly energy consumption and standard deviation in kWh/m² by Heat Pumps components servicing the given activity for Belgium

Activity type	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCOTBER	NOVEMBER	DECEMBER
Cellular Office Area	0.06 (0.00)	0.04 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.16 (0.00)	0.09 (0.00)

2.4.5 Activity types – monthly energy use/m² summary by Heat rejection component

This table shows the measured ranges of monthly energy use recorded for this component type.

Table 14 – Measured average monthly energy consumption and standard deviation in kWh/m² by Heat rejection components servicing the given activity for Belgium

Activity type	ANNUAL TOTAL	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCOTBER	NOVEMBER	DECEMBER
Cellular Office Area - multiple occupation	0.33 (0.01)	0.03 (0.00)	0.03 (0.00)	0.03 (0.00)	0.02 (0.00)	0.02 (0.00)	0.02 (0.00)	0.04 (0.03)	0.04 (0.02)	0.03 (0.01)	0.02 (0.01)	0.03 (0.00)	0.04 (0.00)
Circulation area (corridors and stairways)	0.20 (0.01)	0.02 (0.00)	0.02 (0.00)	0.02 (0.00)	0.01 (0.00)	0.01 (0.00)	0.01 (0.00)	0.03 (0.02)	0.03 (0.01)	0.02 (0.01)	0.01 (0.00)	0.02 (0.00)	0.02 (0.00)
IT: Server Room	4.30 (0.15)	1.09 (0.00)	1.06 (0.00)	1.36 (0.00)	0.25 (0.03)	0.26 (0.01)	0.26 (0.00)	0.28 (0.03)	1.36 (0.09)	1.29 (0.10)	1.35 (0.10)	1.03 (0.00)	1.12 (0.00)
Laboratory	0.42 (0.01)	0.04 (0.00)	0.04 (0.00)	0.04 (0.00)	0.03 (0.00)	0.03 (0.00)	0.03 (0.01)	0.06 (0.05)	0.06 (0.03)	0.04 (0.02)	0.03 (0.01)	0.04 (0.00)	0.05 (0.00)
Laboratory with fume cupboards	0.85 (0.03)	0.08 (0.00)	0.08 (0.00)	0.09 (0.00)	0.10 (0.07)	0.10 (0.06)	0.11 (0.07)	0.16 (0.13)	0.14 (0.10)	0.10 (0.06)	0.09 (0.04)	0.08 (0.00)	0.09 (0.00)
Library - stacks and storeroom	0.62 (0.02)	0.06 (0.00)	0.06 (0.00)	0.07 (0.00)	0.04 (0.00)	0.04 (0.00)	0.04 (0.01)	0.09 (0.06)	0.08 (0.04)	0.05 (0.02)	0.05 (0.01)	0.06 (0.00)	0.07 (0.00)
Toilet	0.31 (0.01)	0.03 (0.00)	0.03 (0.00)	0.03 (0.00)	0.02 (0.00)	0.02 (0.00)	0.02 (0.01)	0.05 (0.04)	0.05 (0.02)	0.03 (0.01)	0.02 (0.01)	0.03 (0.00)	0.03 (0.00)

2.4.6 Activity types – monthly energy use/m² summary by Pumps component

This table shows the measured ranges of monthly energy use recorded for this component type.

Table 15 – Measured average monthly energy consumption and standard deviation in kWh/m² by Pumps components servicing the given activity for Belgium

Activity type	ANNUAL TOTAL	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCOTBER	NOVEMBER	DECEMBER
Cellular Office Area - multiple occupation	0.00 (0.00)	0.54 (0.00)	0.45 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.50 (0.00)	0.55 (0.00)
Circulation area	2.97 (0.09)	0.30 (0.00)	0.29 (0.00)	0.31 (0.00)	0.19 (0.00)	0.19 (0.00)	0.19 (0.02)	0.30 (0.12)	0.30 (0.10)	0.25 (0.08)	0.24 (0.05)	0.27 (0.00)	0.33 (0.00)

Activity type													
(corridors and stairways)													
IT: Server Room	2.97 (0.09)	0.30 (0.00)	0.29 (0.00)	0.31 (0.00)	0.19 (0.00)	0.19 (0.00)	0.19 (0.02)	0.31 (0.13)	0.31 (0.11)	0.25 (0.08)	0.24 (0.04)	0.27 (0.00)	0.33 (0.00)
Laboratory	0.00 (0.00)	0.56 (0.00)	0.54 (0.00)	0.76 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.89 (0.00)	0.83 (0.00)	0.87 (0.00)	0.55 (0.00)	0.55 (0.00)
Laboratory with fume cupboards	8.30 (0.26)	0.83 (0.00)	0.82 (0.00)	0.87 (0.00)	0.53 (0.00)	0.52 (0.00)	0.54 (0.05)	0.87 (0.37)	0.87 (0.31)	0.70 (0.22)	0.66 (0.12)	0.74 (0.00)	0.91 (0.00)
Library - stacks and storeroom	8.30 (0.26)	0.83 (0.00)	0.82 (0.00)	0.87 (0.00)	0.53 (0.00)	0.52 (0.00)	0.54 (0.05)	0.87 (0.37)	0.87 (0.31)	0.70 (0.22)	0.66 (0.12)	0.74 (0.00)	0.91 (0.00)
Toilet	1.14 (0.04)	0.11 (0.00)	0.11 (0.00)	0.12 (0.00)	0.07 (0.00)	0.07 (0.00)	0.07 (0.01)	0.12 (0.05)	0.12 (0.04)	0.10 (0.03)	0.09 (0.02)	0.10 (0.00)	0.13 (0.00)

2.4.7 Activity types – monthly energy use/m² summary by Terminal Units component

This table shows the measured ranges of monthly energy use recorded for this component type.

Table 16 – Measured average monthly energy consumption and standard deviation in kWh/m² by Terminal Units components servicing the given activity for Belgium

Activity type	ANNUAL TOTAL	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCOTBER	NOVEMBER	DECEMBER
Cellular Office Area - multiple occupation	7.25 (0.25)	0.72 (0.00)	0.71 (0.00)	0.76 (0.00)	0.46 (0.00)	0.46 (0.00)	0.43 (0.00)	0.49 (0.00)	0.58 (0.14)	0.59 (0.16)	0.61 (0.11)	0.65 (0.00)	0.79 (0.00)
Circulation area (corridors and stairways)	7.25 (0.25)	0.72 (0.00)	0.71 (0.00)	0.76 (0.00)	0.46 (0.00)	0.46 (0.00)	0.43 (0.00)	0.49 (0.00)	0.58 (0.14)	0.59 (0.16)	0.61 (0.11)	0.65 (0.00)	0.79 (0.00)
Laboratory	7.25 (0.25)	0.72 (0.00)	0.71 (0.00)	0.76 (0.00)	0.46 (0.00)	0.46 (0.00)	0.43 (0.00)	0.49 (0.00)	0.58 (0.14)	0.59 (0.16)	0.61 (0.11)	0.65 (0.00)	0.79 (0.00)
Laboratory with fume cupboards	7.25 (0.25)	0.72 (0.00)	0.71 (0.00)	0.76 (0.00)	0.46 (0.00)	0.46 (0.00)	0.43 (0.00)	0.49 (0.00)	0.58 (0.14)	0.59 (0.16)	0.61 (0.11)	0.65 (0.00)	0.79 (0.00)
Library - stacks and storeroom	7.25 (0.25)	0.72 (0.00)	0.71 (0.00)	0.76 (0.00)	0.46 (0.00)	0.46 (0.00)	0.43 (0.00)	0.49 (0.00)	0.58 (0.14)	0.59 (0.16)	0.61 (0.11)	0.65 (0.00)	0.79 (0.00)

2.5 Measured data accuracy

The actual floor areas are expected to be between -1 to +4% of the value recorded in the iSERV spreadsheet, and the maximum expected error in the read for each electricity and gas meter is ± 2% [Knight 2014]. For heat meters the expected errors are around - 10% based on studies of the actual performance of installed heat meters in Sweden [Jomni 2006] and observations of installation practice in real buildings.

The findings presented here should be read with these potential inaccuracies in mind.

3   References

Knight I P – "Measured Energy Use and Power Demands in European HVAC Components", CIBSE ASHRAE Technical Symposium, Dublin, Ireland, 3-4 April 2014.

Jomni Y, v. Deventer J and Delsing J – "Comparing heat measurement accuracy of a new adaptive algorithm with existing heat meters in accordance to the Swedish test standard", 10th International Symposium on District Heating and Cooling, September 3 – 5, 2006.