iSERV Measured Data Analysis by HVAC Component and Activity - Cyprus

By

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1 Introduction

This report presents the measured HVAC component and end use activity data obtained for Cyprus 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 Cyprus 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	Gas	Heat	Water
Cellular Office Area	6			
Laboratory	4			
Open Plan Office Area	4			

2.1   Overall HVAC Components and Activities Summary

iSERV Measured Data Analysis – Cyprus

Table 1 summarises the data collected for the HVAC Components and the iSERV Activity types available in Cyprus. It can be seen that the HVAC components in this country service 3 total activity types with areas ranging in size from 625 to 2045 m^2. There was an average of 1meter available for each system analysed.

The most frequently encountered component type in this country was Terminal Units and Air Handling Units. The number following the comma for each component type shows how many had sub-metering which addressed their energy use. This sub-metering could be either dedicated to the component or cover a series of HVAC components.

Table 1 – Overall Systems Summary for Cyprus 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	# of spaces	Air Handling Units	All-in-One Systems	Cold Generators	Heat Generators	Heat Pump	Heat Recovery	Heat Rejection	Humidifiers	Pumps	Terminal Units
Cellular Office Area	2045	9	6				4					10
Laboratory	625	3	6				3					4
Open Plan Office Area	840	1	6				3					4

2.2 Summary of measured monthly energy use by HVAC Sub-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 sub-component types servicing the noted end use activity across Cyprus.

What it does illustrate is how the consumption of each sub-component varies with the month of the year.

2.2.1.1   Activity types – monthly energy use/m² summary by Air Handling Units- Electricity Consumption
This table shows the measured ranges of monthly energy use recorded for this sub-component type.

Table 2 – Measured average monthly energy consumption (standard deviation) in kWh/m² by Air Handling Units - Electricity Consumption servicing the given activity for Cyprus

Activity type	ANNUAL TOTAL	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
Cellular Office Area	-	0.1838 (0.00)	0.1489(0.00)	0.0922(0.00)	0.1215(0.00)								
Laboratory	-	0.573 (0.00)	0.4643(0.00)	0.2875(0.00)	0.3788 (0.00)								
Open Plan Office Area	-	0.2056 (0.00)	0.1666(0.00)	0.1032(0.00)	0.1359(0.00)								

2.2.1.2   Activity types – monthly energy use/m² summary by Heat Pump - Electricity Consumption
This table shows the measured ranges of monthly energy use recorded for this sub-component type.

Table 3 – Measured average monthly energy consumption (standard deviation) in kWh/m² by Heat Pump - Electricity Consumption servicing the given activity for Cyprus

Activity type	ANNUAL TOTAL	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
Cellular Office Area	-	1.909 (1.5206)	1.4196 (1.111)	0.991 (0.7249)	1.675 (1.9902)								
Laboratory	-	1.909(1.5206)	1.4196 (1.111)	0.991 (0.7249)	0.6986 (0.4711)								
Open Plan Office Area	-	1.909(1.5206)	1.4196 (1.111)	0.991 (0.7249)	0.6987(0.4711)								

2.2.1.3   Activity types – monthly energy use/m² summary by Terminal Units - Electricity Consumption
This table shows the measured ranges of monthly energy use recorded for this sub-component type.

Table 4 – Measured average monthly energy consumption (standard deviation) in kWh/m² by Terminal Units - Electricity Consumption servicing the given activity for Cyprus

Activity type	ANNUAL TOTAL	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
Cellular Office Area	-	0.2444 (0.0409)	0.2304 (0.061)	0.1948 (0.0826)	0.4334 (0.261)								
Laboratory	-	0.1969(0.00)	0.1595 (0.00)	0.0988(0.00)	0.1301 (0.00)								
Open Plan Office Area	-	0.1969(0.00)	0.1595 (0.00)	0.0988 (0.00)	0.1301(0.00)								

2.3 Summary Conclusions

Unfortunately there is not a lot of data for the Cyprus buildings so a lot of the tables in the report are empty.

3   Detailed Data Summary and Analysis

This section examines each System in detail, along with summaries of the measured data in the first column of each table. The summaries are used in the overview section in this report.

The data is considered at the level of consumption by HVAC component using the following metrics: kWh/m^2 by month.

The data in this section is derived directly from the HERO database and is normalised to the floor areas allocated to each HVAC component within the iSERV spreadsheet for each building.

3.1   *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.

3.2 Summary of measured monthly energy use by HVAC component type and Sub-type
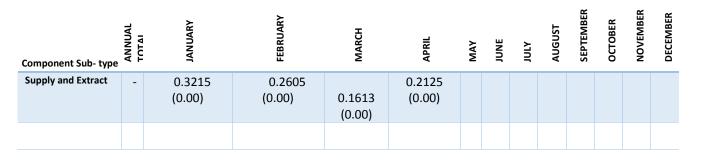
The data is considered at the level of consumption by HVAC component using the following metrics: kWh/m2 by month.

The tables in this section provide the ranges of average and standard deviation monthly energy consumptions found in different HVAC sub-component types across Cyprus. This data does not take into account the activities being serviced.

3.2.1.1 Sub-component – monthly energy use/m² summary by Air Handling Units-Supply and Extract Electricity Consumption

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

Table 5 – Measured average monthly energy consumption (standard deviation) in kWh/m² by Air Handling Units – Suplly and Extract- monthly Electricity Consumption for Cyprus

Component Sub- type	ANNUAL TOTAI	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
Supply and Extract	-	0.3215 (0.00)	0.2605 (0.00)	0.1613 (0.00)	0.2125 (0.00)								

3.2.1.2 Sub-component – monthly energy use/m² summary by Heat Pump-Air Source reverse cycle – cooling optimised- Electricity Consumption

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

Table 6 – Measured average monthly energy consumption (standard deviation) in kWh/m² by Heat Pump – Air Source reverse cycle – cooling optimised - monthly Electricity Consumption for Cyprus

Component Sub- type	ANNUAL TOTAI	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
Air Source reverse cycle – cooling optimised	-	1.909 (1.5206)	1.4196 (1.111)	0.991 (0.7249)	1.675 (1.9902)								

3.2.1.3 *Sub-component – monthly energy use/m² summary by Terminal Unit – Fan Coils – 2 or 4 tubes - Electricity Consumption*

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

Table 7 – Measured average monthly energy consumption (standard deviation) in kWh/m² by Terminal Unit – Fan Coils – 2 or 4 tubes - monthly Electricity Consumption for Cyprus

Component Sub- type	ANNUAL TOTAL	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
Fan Coils – 2 or 4 tubes	-	0.2444 (0.0409)	0.2304 (0.061)	0.1948 (0.0826)	0.4334 (0.261)								

4 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.