K2n operational targets and data requirements

20th October 2023

Contents

1 Overview

This document is split into four sections. These cover:

- Energy targets
- Initial services design and the data collection process for meters and sensors.
- Commissioning stage
- Providing robust data

The procedure for storing and sending the collected data is identical for both meters and sensors, but the setup requirements for a robust system are different for each.

The basis of the K2n methodology and platform is that operational data is only useful if it is trusted and informs actions. If there is uncertainty about its accuracy, then action is unlikely to follow.

1.1 K2n energy targets

The overarching needs for the energy data provided to K2n are that it must:

- Allow confirmation of the achieved performance against the end use and overall targets.
- Be robust enough to withstand challenge e.g. some meter redundancy should be included.
- Inform the various parties (occupants, contractors, clients) where the energy is going so that opportunities for improvement are clear along with who might take the actions needed to achieve those improvements.

1.1.1 School Design Targets

For schools, K2n currently conform to the published Department for Education End Use Intensity Design Targets in their 2017 to 2021 Output Specifications. This is to avoid complicating contractual arrangements in this sector. The relevant targets for contracts signed before and from November 1st, 2021 are shown in the tables below:

2017 and 2019 Design Energy Targets

Table 2 Energy Weighting Factors

Category	Description	Energy Weighting Factor*
Electricity	includes mains electricity, electricity from combined heat and power and renewable energy	1.0
All fuels	includes, gas, oil, and biofuels	0.4
All thermal energy	includes geothermal, district heat and heat from combined heat and power and solar thermal	0.5

* The energy targets are quoted based on the Operational Hours detailed in Section 0.

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Table 3 Annual Design Energy Targets - Primary

Type	Heating	Hot Water	Small Power	Lighting	Fans and Pumps	Cooling	Lifts	Total
Electrical equivalent (kWh/m²)	21	4	10	13	7	1	1	**57**
Allow 4 kWh/m² for building related services							**Total**	**61**

Table 4 Annual Design Energy Targets - Secondary

Type	Heating	Hot Water	Small Power	Lighting	Fans and Pumps	Cooling	Lifts	Total
Electrical equivalent (kWh/m²)	20	4	25	13	7	1	1	**71**
Allow 4 kWh/m² for building related services							**Total**	**75**

2021 Design Energy Use Intensity Targets

3.2.2 Energy Use Intensity Targets

3.2.2.1 To meet the EUI Targets, the energy model shall have energy end use for school per m² of GIFA (kWh/m2) excluding unheated (transition spaces). [PM_40_20]

3.2.2.2 The following EUI values define the minimum standards for New Building(s) and shall be achieved before the application of renewable technology. [PM_40_20]

School Type	Energy Use Intensity (minimum)	Units
Primary School	52	kWh/m²
Secondary School	67	kWh/m²
SEN_D	52	kWh/m²

Table 1 Energy Use Intensity Targets

3.2.2.3 The following breakdown below provides an indication of how to achieve the overa EUI targets, by end use system. [PM_40_30_27]

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Parameter	Value	Units
Heating	8	kWh/m²
Hot Water	5	kWh/m²
Internal lighting	8	kWh/m²
Fans and pumps	5	kWh/m²
Cooling	0	kWh/m²
Lifts	1	kWh/m²
Building related services	2	kWh/m²
External Lighting	6	kWh/m²
Small power (Primary)	10	kWh/m²
Small power (Secondary)	25	kWh/m²
Small power (SEN_D)	10	kWh/m²
Catering	7	kWh/m²
ICT equipment and active infrastructure	*Included within Small Power*	*Included within Small Power*

Table 2 End Use Energy Benchmarks

1.1.2 Other Buildings Design Targets

For all other buildings, K2n will produce a unique set of benchmark ranges per building. These are derived where possible from measured performance in operational buildings. The ranges are set with consideration of the activities, areas and servicing solutions used in the 'as built' building.

The K2n targets to be met will be those that meet the lower quartile boundary of expected performance for the as built building. Where significant or unusual process loads are present in the occupied building then these must be separately metered, along with their services, to allow their influence to be separately assessed.

1.2 Utilities design suggestions

Any metering and monitoring provided should enable actions to be taken from the data produced. The monitoring should inform those responsible for specific energy end uses of the performance being achieved for that end use, so action can be taken if needed. A key aspect is of this is a clear separation of energy use by occupants from energy use by the building services plant.

The following utilities design approaches are recommended:

Design item	Examples
Supplies to building services to be separated from supplies to end users	All Mechanical Plant should be on its own separately metered distribution board(s). Separate Gas meters for Heating Systems and DHW. Separate Gas meters for Catering and Process Uses
All energy supplies to be separately metered. Exported energy must also be separately metered.	- PV, Wind, CHP, etc must have their contributions/ consumptions separately metered and reported. - The Main Incoming Electrical Supply Meter from the Grid should have its IMPORT and EXPORT values metered where there is onsite electricity generation. - In the case of heating and/or cooling being exported/ imported as part of a district scheme then these quantities must be metered to quantify the contribution/extraction of energy to these schemes.
Main incoming supplies for each utility should be metered and have a full set of submeters	All utilities and their initial sub-circuits must be metered. This enables verification of recorded loads to ensure robustness of the data.
Lighting and Small Power supplies to be separately metered.	This is commonly achieved through split panels with separate metering. Do NOT mix with MECH supplies
Significant and balance loads should be separately metered	Server Rooms, Catering, Lifts all warrant their own circuit and meter. Small loads such as Fire Alarm Panels, Disabled Refuge Alarm Panels, etc do not require metering but would benefit from it as part of ensuring data quality
Do not connect mechanical plant back to Small Power or Lighting circuits UNLESS the plant has its own in-built monitoring that will be used to separate its load	For example, some AHU's have in-built fan power monitoring as well as the ability to monitor heat supplied, room conditions, etc. These are capable of being connected back to the main data collection system.
Allow for BMS data collection connections to inbuilt monitoring on individual plant such as pumps, AHU's, AC units, etc	Where separating plant utility use would require significant additional wiring and/or meters to achieve, then use of inbuilt monitoring may prove more cost-effective. Common for NVHR units T and CO2 already.
External conditions	External conditions must be measured with at least one high quality, well installed air temperature sensor. A full weather station with full solar, wind speed and wind direction instruments is desirable for post-occupancy tuning of the operation of the building
Internal Environmental Quality	At a minimum room air temperature/black bulb thermometers AND good CO2 sensors should be installed in all regularly occupied main teaching spaces. VOC sensors are a very useful addition if affordable.

1.2.1 All- electric buildings

In addition to the design issues noted in the previous table, the following issues are further clarified for all-electric buildings

Design item	Examples
Separating electricity use for heating and electricity use for DHW generation from all other electricity use	The use of electric panel heaters and point-of-use electric DHW boilers needs careful planning. The requirement is to separate occupant-controlled electricity use i.e. Small Power and Lighting, from that needed to provide the required internal conditions i.e. building demands such as heating, cooling and DHW. The options are: - To separately meter heating and DHW supplies. This may need to be at individual circuit level if supplied from normal sub-distribution boards. Metering systems exist for this approach. - To install plant which can record its own electricity use, etc and collect this information as needed - For electricity DHW use, the water consumption also needs metering. This is to allow draining down and turning off of unused supplies for periods of the year. Ideally two cold water supplies would be run per outlet – one for DHW and one for CWS. These would all be joined to a meter for each circuit. - This arrangement also allows for a future switch to centralised DHW if this proves preferable. - BCWS and other cold water circulation pumpsets need to be separately metered.
Heat Pumps – both heating and cooling	To separate the heating and cooling energy DEMAND of the building from the ENERGY consumption for heating and cooling then metering should be arranged to understand both. This can be as follows: - Collection of onboard data from each system showing energy used and heating/cooling delivered - Electrical and heat metering on all circuits - This level of detail is not required for Server Room cooling equipment but this plant is still required to be metered separately from the Server Room equipment

1.3 Commissioning Stage (or the SOAK Test)

During the pre-handover commissioning or soak test of all the building systems, or IDEALLY as soon as the BMS is energised and collecting data, the following sets of data should be collected and sent to the k2n email address provided for the school:

Meters:

- A set of manual meter readings and/or photos, taken at two different times, recording both **time of reading** and the **meter reading value** from each physical meter in the school. **This should include ALL Supplier Utility Meters too.**
- Ideally, the first readings should be from the start of the soak test period and the second from the end of the soak test. This will normally be a few days minimum. The main need is that the readings are taken for each meter at the same time (within a few minutes is fine) and that enough time is allowed for consumptions to be established for each meter.
- If the meters do not increment regularly, ideally every 15 minutes, ensure their resolution is correct for the load. Provide units for each meter if not kWh or m^3.
- For electricity meters, a minimum resolution of 0.1 kWh, but Wh is also fine.
- For gas and water meters, 0.1 m^3 should be aimed for as a minimum resolution.
- For heat meters, kWh are preferable to MWh.
- To accompany the manual readings the concurrent 15-minute data recorded over the soak test period by the BMS should also be sent as a csv data file to the given email address.
- Manually calculate the consumption recorded over the period of the readings by the meters.
- The sum of the submeters consumption for each utility being monitored (electricity, gas, heat and water normally) should be compared with the consumption of the main incomer. These two values should be within 2% ideally for all utilities, but up to 5% might be OK.

Sensors:

- For the Temp and CO_2 sensors in each space, record the time and values shown by a hand-held T & CO_2 probe.
- Compare these with the readings showing for that space on the BMS at time of readings.
- The recorded values and time of each sensor reading should then sent to K2n along with the corresponding BMS data recorded.
- Readings should normally be within 0.3°C or 25 ppm of each other

K2n will also check the manual readings and sensor values against the readings and values provided by the BMS to identify any data collection problems.

These tests are essential to ensuring the data used is accurate and verified before contractors leave the site and can save £000's in costs c.f. rectifying later. The most common errors arise from:

- Meters not being connected
- Meters not working (especially gas and water)
- Incorrect meter multipliers used (especially gas and water)
- Incorrect BMS to meter setups
- Poor labelling of meters and/or sensors leading to uncertainty as to what they are
- Uncertainty over how DB board elec Light and Power meters relate to each other
- Main Elec Incomer not providing both IMPORT and EXPORT readings where PV is installed
- Inability to send the daily data files to K2n due to lack of internet email connection

1.3.1 The SOAK Test Checklist

The table below summarises the key K2n elements proposed for the Soak test:

Element	Notes	Complete
Photos, taken over a few days minimum, recording both time of reading and the meter reading value for each physical meter in the school		
Each meter's resolution has been checked as appropriate for its connected load		
The 15-minute data recorded during the soak test by the BMS FOR EACH METER and SENSOR has been sent in csv format to the given K2n email address, along with the photos		
A calculation of the sum of the submeters consumption during the soak test yields a value within +/- 2% of the main incomer consumption for each utility		
Measured T and CO_2 within sample spaces matches the data shown at the BMS at the time within 0.3°C or 25 ppm		
The measured T and CO2 values for each named space, and the time taken, have been sent to the given K2n email address		

As noted earlier, you would ideally have tested and verified the accuracy and operation of the data collection systems BEFORE the Soak Test commences so that you can confidently use the data as part of the Soak Test checks.

1.4 Providing robust data to K2n

1.4.1 Meter data

There are a series of 'good practice' decisions which should ensure smooth installation and commissioning. The key points considered essential to follow are:

1.4.1.1 Metering: Design stage:

Example BMS Meter Points Partial Table

The following are examples of each type of the key meter data that need to be recorded in the BMS points. Their description should coincide with the meters and sensors noted as installed in the building assets supplied to K2n:

Label	Units	
EM01_Elec_Main_Incomer	kWh	
EM02_Refuge_Alarm_Panel	kWh	
EM03_Fire_Alarm_Panel	kWh	
EM04_BMS_MCC1	kWh	
EM05_EXT_Lighting	kWh	
EM06_Lift	kWh	
EM07_PV_Array	kWh	
EM08_DB_GF_VentPower	kWh	
EM09_DB_1F_VentPower	kWh	
EM10_DB_GF_12_KitchenPower	kWh	
EM11_DB_GF_11_AVPower	kWh	
EM12_DB_GF_10_ICTPower	kWh	
EM13_DB_GF_09_ITPower	kWh	
EM14_DB_GF_08_SciencePower	kWh	
EM15_DB_GF_07_RES MAT Power	kWh	
EM16_DB_GF_06_ARTPower	kWh	
EM17_DB_GF_05_FoodTECHPower	kWh	Each meter has its data initially recorded into the BMS database or other data collector system. This data is then all packaged into a csv file or files each evening for sending to the K2n platform
EM18_DB_GF_04_SELights	kWh	
EM19_DB_GF_04_SEPower	kWh	
EM20_DB_GF_03_NELights	kWh	
EM21_DB_GF_03_NEPower	kWh	
EM22_DB_GF_02_NWLights	kWh	
EM23_DB_GF_02_NWPower	kWh	
EM24_DB_GF_01_SWLights	kWh	
EM25_DB_GF_01_SWPower	kWh	
EM26_DB_1F_05_ServerRMPower	kWh	
EM27_DB_1F_04_PlantRoom	kWh	
EM28_DB_1F_03_SELights	kWh	
EM29_DB_1F_03_SEPower	kWh	
EM30_DB_1F_02_NELights	kWh	
EM31_DB_1F_02_NEPower	kWh	
EM32_DB_1F_01_NWLights	kWh	
EM33_DB_1F_01_NWPower	kWh	
GM01_Main_Gas_Incomer	m^3	
GM02_Boiler Gas	m^3	
GM03_Kitchen Gas	m^3	
GM04_DHW_Gas	m^3	
WM01_Boundary_Water	m^3	
WM02_Main_Water_Incomer	m^3	
WM03_CAT5	m^3	
WM04_DHW_Calorifier_Water	m^3	
WM05_Existing_Building_Supply	m^3	
WM06_Kitchen_DHW_Supply	m^3	
WM07_Kitchen_CWS_Supply	m^3	
HM01_VT_Circuit_1	kWh	
HM02_VT_Circuit_2	kWh	
HM03_CT_Circuit_1	kWh	
HM04_CT_Circuit_2	kWh	

- The electricity, gas, heat and water distribution systems are designed to allow clear separation of consumption by the desired end uses and plant served.
- Sub-metering is applied to ALL sub-circuits fed directly from the main incomer(s) for each utility. This allows correlation of submeter demands with main meters
- Ensure ALL incoming supplies are accurately metered – **including separate Incomer Import and Export readings where PV, batteries or other on-site storage/ generation is installed.**
- Choose a data collection system capable of collecting readings at 15-minute intervals, storing this data, and automatically sending it to K2n in csv format via an email each evening at a specified time
- Ensure an email server and internet connection are available for the data transmission system to be used

1.4.1.2 Metering: Construction stage:

- Sized to provide useful resolution readings over each 15-minute for the design loads served e.g. kWh not MWh for a heat meter recording DHW energy use
- Gas meters Qmin to be sized for the actual demands
- Meters to have documentation showing the circuits and plant they serve 'as-built'
- All meters installed have calibration certificates showing their accuracy over their range

Example BMS csv data file output for one day

Note the data for each meter should be the ACTUAL READING at each 15 minute interval, NOT an interpolation. **This csv data should be sent each night via email to the unique email address given for the school** once the final reading for the day has been taken and stored. This email address is of the form 'school_name_15min_data@data.k2nenergy.com'. The example file for one day shows data for just the first 8 meters as examples, but all meter and sensor data could be in here too. Note that the column headings contain the BMS labels for each data stream

timestamp	EM01_Elec_Main_Incomer	EM02_Refuge_Alarm_Panel	EM03_Fire_Alarm_Panel	EM04_BMS_MCC1	EM05_EXT_Lighting	EM06_Lift	EM07_PV_Array	EM08_DB_GF_VentPower	Etc for all meter and sensor points...
05/10/2020 00:00	89514	0.96	12.10	6189.1	578.8	2.59	2384.2	31.6	
05/10/2020 00:15	89520	0.96	12.11	6189.3	578.9	2.59	2384.2	31.6	
05/10/2020 00:30	89520	0.96	12.11	6189.3	579	2.59	2384.2	31.6	
05/10/2020 00:45	89526	0.96	12.12	6189.4	579.1	2.59	2384.2	31.6	
05/10/2020 01:00	89526	0.96	12.12	6189.4	579.2	2.59	2384.2	31.6	
05/10/2020 01:15	89531	0.96	12.13	6189.6	579.4	2.59	2384.2	31.6	
05/10/2020 01:30	89531	0.96	12.13	6189.6	579.5	2.59	2384.2	31.6	
05/10/2020 01:45	89537	0.96	12.14	6189.8	579.6	2.59	2384.2	31.6	
05/10/2020 02:00	89537	0.96	12.14	6189.8	579.7	2.59	2384.2	31.6	
05/10/2020 02:15	89543	0.96	12.15	6190.2	579.8	2.59	2384.2	31.6	
05/10/2020 02:30	89543	0.97	12.15	6190.2	579.9	2.59	2384.2	31.6	
05/10/2020 02:45	89549	0.97	12.16	6190.3	580	2.59	2384.2	31.6	
05/10/2020 03:00	89549	0.97	12.16	6190.3	580.1	2.59	2384.2	31.7	
05/10/2020 03:15	89555	0.97	12.17	6190.5	580.3	2.59	2384.2	31.7	
05/10/2020 03:30	89555	0.97	12.17	6190.5	580.4	2.59	2384.2	31.7	
05/10/2020 03:45	89561	0.97	12.18	6190.6	580.5	2.59	2384.2	31.7	
05/10/2020 04:00	89561	0.97	12.18	6190.6	580.6	2.59	2384.2	31.7	
05/10/2020 04:15	89566	0.97	12.19	6190.7	580.7	2.59	2384.2	31.7	
05/10/2020 04:30	89566	0.97	12.19	6190.7	580.8	2.59	2384.2	31.7	
05/10/2020 04:45	89573	0.97	12.20	6190.9	580.9	2.59	2384.2	31.7	
05/10/2020 05:00	89573	0.97	12.20	6190.9	581	2.59	2384.2	31.7	
05/10/2020 05:15	89578	0.97	12.21	6191	581.1	2.59	2384.2	31.7	
05/10/2020 05:30	89578	0.97	12.21	6191	581.3	2.59	2384.2	31.7	
05/10/2020 05:45	89584	0.97	12.22	6191.1	581.4	2.59	2384.2	31.7	
05/10/2020 06:00	89584	0.97	12.22	6191.1	581.5	2.59	2384.2	31.7	
05/10/2020 06:15	89590	0.97	12.23	6191.5	581.6	2.59	2384.2	31.7	
05/10/2020 06:30	89590	0.97	12.23	6191.5	581.7	2.59	2384.2	31.7	
05/10/2020 06:45	89596	0.97	12.24	6191.7	581.8	2.59	2384.2	31.7	
05/10/2020 07:00	89596	0.97	12.24	6191.7	581.9	2.59	2384.2	31.7	
05/10/2020 07:15	89602	0.97	12.25	6191.8	581.9	2.59	2384.2	31.7	
05/10/2020 07:30	89602	0.98	12.25	6191.8	582	2.59	2384.2	31.7	
05/10/2020 07:45	89607	0.98	12.26	6192	582	2.59	2384.2	31.7	
05/10/2020 08:00	89607	0.98	12.26	6192	582	2.59	2384.2	31.7	
05/10/2020 08:15	89613	0.98	12.27	6192.3	582	2.59	2384.2	31.7	
05/10/2020 08:30	89613	0.98	12.27	6192.3	582	2.6	2384.2	31.7	
05/10/2020 08:45	89619	0.98	12.28	6192.5	582	2.6	2384.2	31.7	
05/10/2020 09:00	89619	0.98	12.28	6192.5	582	2.6	2384.3	31.7	
05/10/2020 09:15	89625	0.98	12.29	6192.6	582.1	2.6	2384.4	31.7	
05/10/2020 09:30	89625	0.98	12.29	6192.6	582.1	2.61	2384.5	31.7	
05/10/2020 09:45	89631	0.98	12.30	6192.8	582.1	2.61	2384.6	31.7	
05/10/2020 10:00	89631	0.98	12.30	6192.8	582.1	2.61	2384.7	31.7	
05/10/2020 10:15	89637	0.98	12.31	6192.9	582.1	2.61	2384.8	31.7	
05/10/2020 10:30	89637	0.98	12.31	6192.9	582.1	2.61	2384.9	31.7	
05/10/2020 10:45	89642	0.98	12.32	6193.2	582.1	2.61	2385	31.7	
05/10/2020 11:00	89642	0.98	12.32	6193.2	582.1	2.61	2385.2	31.7	
05/10/2020 11:15	89648	0.98	12.33	6193.3	582.2	2.61	2385.4	31.7	
05/10/2020 11:30	89648	0.98	12.33	6193.3	582.2	2.62	2385.6	31.7	
05/10/2020 11:45	89653	0.98	12.34	6193.5	582.2	2.62	2385.8	31.7	
05/10/2020 12:00	89653	0.98	12.34	6193.5	582.2	2.62	2386	31.8	
05/10/2020 12:15	89659	0.98	12.35	6193.7	582.2	2.62	2386.2	31.8	
05/10/2020 12:30	89659	0.99	12.35	6193.7	582.2	2.62	2386.4	31.8	
05/10/2020 12:45	89664	0.99	12.36	6193.8	582.2	2.63	2386.6	31.8	
05/10/2020 13:00	89664	0.99	12.36	6193.8	582.3	2.63	2386.8	31.8	
05/10/2020 13:15	89669	0.99	12.37	6194	582.3	2.63	2387	31.9	
05/10/2020 13:30	89669	0.99	12.37	6194	582.3	2.64	2387.2	31.9	
05/10/2020 13:45	89674	0.99	12.38	6194.2	582.3	2.64	2387.4	31.9	
05/10/2020 14:00	89674	0.99	12.38	6194.2	582.3	2.64	2387.6	31.9	
05/10/2020 14:15	89679	0.99	12.39	6194.4	582.3	2.64	2387.6	31.9	
05/10/2020 14:30	89679	0.99	12.39	6194.4	582.3	2.64	2387.6	31.9	
05/10/2020 14:45	89683	0.99	12.40	6194.6	582.3	2.65	2387.6	31.9	
05/10/2020 15:00	89683	0.99	12.40	6194.6	582.4	2.65	2387.6	32	
05/10/2020 15:15	89688	0.99	12.41	6194.7	582.4	2.65	2387.6	32.1	
05/10/2020 15:30	89688	0.99	12.41	6194.7	582.4	2.65	2387.6	32.2	
05/10/2020 15:45	89692	0.99	12.42	6194.9	582.4	2.66	2387.6	32.3	
05/10/2020 16:00	89692	0.99	12.42	6194.9	582.4	2.66	2387.6	32.4	
05/10/2020 16:15	89696	0.99	12.43	6195.1	582.4	2.66	2387.6	32.5	
05/10/2020 16:30	89696	0.99	12.43	6195.1	582.5	2.66	2387.6	32.6	
05/10/2020 16:45	89700	0.99	12.44	6195.2	582.6	2.67	2387.6	32.7	
05/10/2020 17:00	89700	0.99	12.44	6195.2	582.7	2.67	2387.6	32.8	
05/10/2020 17:15	89704	0.99	12.45	6195.5	582.8	2.67	2387.6	32.8	
05/10/2020 17:30	89704	1.00	12.45	6195.5	582.9	2.67	2387.6	32.8	
05/10/2020 17:45	89707	1.00	12.46	6195.7	583	2.67	2387.6	32.8	
05/10/2020 18:00	89707	1.00	12.46	6195.7	583.1	2.67	2387.6	32.8	
05/10/2020 18:15	89710	1.00	12.47	6195.8	583.2	2.67	2387.6	32.8	
05/10/2020 18:30	89710	1.00	12.47	6195.8	583.4	2.67	2387.6	32.8	
05/10/2020 18:45	89713	1.00	12.48	6196	583.6	2.67	2387.6	32.8	
05/10/2020 19:00	89713	1.00	12.48	6196	583.7	2.67	2387.6	32.8	
05/10/2020 19:15	89715	1.00	12.49	6196.2	583.9	2.67	2387.6	32.8	
05/10/2020 19:30	89715	1.00	12.49	6196.2	584.1	2.67	2387.6	32.8	
05/10/2020 19:45	89717	1.00	12.50	6196.4	584.2	2.67	2387.6	32.8	
05/10/2020 20:00	89717	1.00	12.50	6196.4	584.4	2.67	2387.6	32.8	
05/10/2020 20:15	89719	1.00	12.51	6196.5	584.6	2.67	2387.6	32.8	
05/10/2020 20:30	89719	1.00	12.51	6196.5	584.8	2.67	2387.6	32.8	
05/10/2020 20:45	89720	1.00	12.52	6196.8	584.9	2.67	2387.6	32.8	
05/10/2020 21:00	89720	1.00	12.52	6196.8	585.1	2.67	2387.6	32.8	
05/10/2020 21:15	89721	1.00	12.53	6196.9	585.3	2.67	2387.6	32.8	
05/10/2020 21:30	89721	1.00	12.53	6196.9	585.4	2.67	2387.6	32.8	
05/10/2020 21:45	89721	1.00	12.54	6196.9	585.6	2.67	2387.6	32.8	
05/10/2020 22:00	89723	1.00	12.54	6197.1	585.8	2.67	2387.6	32.8	
05/10/2020 22:15	89723	1.00	12.55	6197.1	585.9	2.67	2387.6	32.8	
05/10/2020 22:30	89724	1.01	12.55	6197.3	586.1	2.67	2387.6	32.8	
05/10/2020 22:45	89724	1.01	12.56	6197.3	586.3	2.67	2387.6	32.8	
05/10/2020 23:00	89725	1.01	12.56	6197.5	586.4	2.67	2387.6	32.8	
05/10/2020 23:15	89725	1.01	12.57	6197.5	586.5	2.67	2387.6	32.8	
05/10/2020 23:30	89727	1.01	12.57	6197.6	586.7	2.67	2387.6	32.8	
05/10/2020 23:45	89727	1.01	12.58	6197.6	586.8	2.67	2387.6	32.8	

1.4.1.3 Metering: Commissioning and operation stage:

- The pulses per monitored unit are provided for each water or gas meter e.g. 1 pulse = 100 litres for a water meter or 1 pulse = 0.1 m^3 of gas. Check water meters particularly.
- Gas and Water READINGS should be sent to K2n by cumulatively adding the pulses to an initial manual reading for each meter. Allows overall consumption to be checked if needed.
- Electricity meters have the meter READING recorded every 15 minutes, not the consumption
- All meters have their ACTUAL value recorded every 15 minutes. Do not use interpolation setting which is designed to reduce space use in the BEMS database.
- Check the data is being sent each night after 00:00 and received at the K2n database

K2n Operational Data Input Table (Partial)

This table shows how the BMS Labels are used in the K2n asset sheet to connect the operational data to the right meter

Name	Meter Type	Unit Type	Unique Meter Id (uses the labels from the csv file)	
Main Electrical Incomer	Electricity	kWh	EM01_Elec_Main_Incomer	
Refuge Alarm Panel	Electricity	kWh	EM02_Refuge_Alarm_Panel	
Fire Alarm Panel	Electricity	kWh	EM03_Fire_Alarm_Panel	
BMS MCC1 Power	Electricity	kWh	EM04_BMS_MCC1	
External Lighting	Electricity	kWh	EM05_EXT_Lighting	
Lift Supply	Electricity	kWh	EM06_Lift	
PV Array Output	Electricity	kWh	EM07_PV_Array	
DB GF Vent Power	Electricity	kWh	EM08_DB_GF_VentPower	
DB 1F Vent Power	Electricity	kWh	EM09_DB_1F_VentPower	
DB GF Kitchen Power	Electricity	kWh	EM10_DB_GF_12_KitchenPower	
DB GF Audio Visual Power	Electricity	kWh	EM11_DB_GF_11_AVPower	
DB GF ICT Power	Electricity	kWh	EM12_DB_GF_10_ICTPower	
DB GF IT Power	Electricity	kWh	EM13_DB_GF_09_ITPower	
DB GF Science Power	Electricity	kWh	EM14_DB_GF_08_SciencePower	
DB GF RM Power	Electricity	kWh	EM15_DB_GF_07_RES MAT Power	
DB GF Art Power	Electricity	kWh	EM16_DB_GF_06_ARTPower	
DB GF Food Tech Power	Electricity	kWh	EM17_DB_GF_05_FoodTECHPower	
DB GF SE Lights	Electricity	kWh	EM18_DB_GF_04_SELights	Note these meters are split panel Lighting and Power meters. The labels should make clear exactly what is being recorded, e.g TOTAL of the board or JUST Power OR Lighting
DB GF SE Power	Electricity	kWh	EM19_DB_GF_04_SEPower	
DB GF NE Lights	Electricity	kWh	EM20_DB_GF_03_NELights	
DB GF NE Power	Electricity	kWh	EM21_DB_GF_03_NEPower	
DB GF NW Lights	Electricity	kWh	EM22_DB_GF_02_NWLights	
DB GF NW Power	Electricity	kWh	EM23_DB_GF_02_NWPower	
DB GF SWLights	Electricity	kWh	EM24_DB_GF_01_SWLights	
DB GF SW Power	Electricity	kWh	EM25_DB_GF_01_SWPower	
DB 1F Server Power	Electricity	kWh	EM26_DB_1F_05_ServerRMPower	
DB 1F Plant Room Power	Electricity	kWh	EM27_DB_1F_04_PlantRoom	
DB 1F SE Lights	Electricity	kWh	EM28_DB_1F_03_SELights	Note these meters are split panel Lighting and Power meters. The labels should make clear exactly what is being recorded, e.g TOTAL of the board or JUST Power OR Lighting
DB 1F SE Power	Electricity	kWh	EM29_DB_1F_03_SEPower	
DB 1F NE Lights	Electricity	kWh	EM30_DB_1F_02_NELights	
DB 1F NE Power	Electricity	kWh	EM31_DB_1F_02_NEPower	
DB 1F NW Lights	Electricity	kWh	EM32_DB_1F_01_NWLights	
DB 1F NW Power	Electricity	kWh	EM33_DB_1F_01_NWPower	
GM01 Main Gas Incomer	Gas	m^3	GM01_Main_Gas_Incomer	
GM02 Boiler Gas	Gas	m^3	GM02_Boiler Gas	
GM03 Kitchen Gas	Gas	m^3	GM03_Kitchen Gas	
GM04 DHW Winter Gas	Gas	m^3	GM04_DHW_Gas	
WM01 Utility Supply Meter	Water	m^3	WM01_Boundary_Water	
WM02 Main Incomer	Water	m^3	WM02_Main_Water_Incomer	
WM03 CAT5	Water	m^3	WM03_CAT5	
WM04 DHW Calorifier	Water	m^3	WM04_DHW_Calorifier_Water	
WM05 Existing Building	Water	m^3	WM05_Existing_Building_Supply	
WM06 Kitchen DHW Use	Water	m^3	WM06_Kitchen_DHW_Supply	
WM07 Kitchen CWS	Water	m^3	WM07_Kitchen_CWS_Supply	
Main Radiator Circuit Heat Use	Heat	kWh	HM01_VT_Circuit_1	
Community Circuit Heat Use	Heat	kWh	HM02_VT_Circuit_2	
AHU Heat Use	Heat	kWh	HM03_CT_Circuit_1	
Solar Thermal DHW Heat Supply	Heat	kWh	HM04_CT_Circuit_2	

1.4.2 Sensor data

For sensors there are also a series of 'good practice' decisions which should ensure smooth installation and commissioning. These are shown for the various stages of design, construction and operation. The bullet points show essential elements to follow:

1.4.2.1 Sensors: Design stage:

BMS Sensor Points Partial Table Example

The following are examples of each type of the key sensor data that need to be recorded in the BMS points. Their description should coincide with the meters and sensors noted as installed in the building assets supplied to K2n:

Label	Units
1st Floor Temp1	Centigrade
1st Floor Temp2	Centigrade
AHU Supply Temp	Centigrade
CT Flow Temp	Centigrade
CT RTN Temp	Centigrade
Ground Floor Temp	Centigrade
HWS Calorifier Temp	Centigrade
HWS Flow Temp	Centigrade
HWS RTN Temp	Centigrade
HWS SECFlow Temp	Centigrade
HWS SECRTN Temp	Centigrade
LTHW Flow Temp	Centigrade
LTHW RTN Temp	Centigrade
Outside Air Temp	Centigrade
VT Flow Temp	Centigrade
VT RTN Temp	Centigrade
0021 Pupil Changing Temp	Centigrade
0022 SportsHall CO2	ppm
0022 SportsHall Temp	Centigrade
0026 Dining RM CO2	ppm
0026 Dining RM Temp	Centigrade
0027 Kitchen RM CO2	ppm
0032 MainHall CO2	ppm
0032 MainHall Temp	Centigrade
0042 YR6 ClassRM CO2	ppm
0042 YR6 ClassRM Temp	Centigrade
0047 Science ClassRM CO2	ppm
0047 Science ClassRM Temp	Centigrade
0051 Workshop CO2	ppm
0051 Workshop Temp	Centigrade
0054 Food ClassRM CO2	ppm
0054 Food ClassRM Temp	Centigrade
0057 ART ClassRM CO2	ppm
0057 ART ClassRM Temp	Centigrade
0065 ICT ClassRM CO2	ppm
0065 ICT ClassRM Temp	Centigrade
0068 GEN ClassRM CO2	ppm
0068 GEN ClassRM Temp	Centigrade
0071 ClassRM CO2	ppm
0071 GEN ClassRM Temp	Centigrade
0074 ClassRM CO2	ppm
0074 GEN ClassRM Temp	Centigrade
0080 GEN ClassRM CO2	ppm
0080 GEN ClassRM Temp	Centigrade
0083 GEN ClassRM CO2	ppm
0083 GEN ClassRM Temp	Centigrade
0086 GEN ClassRM CO2	ppm
0086 GEN ClassRM Temp	Centigrade

Each sensor has its data initially recorded into the BMS database or other data collector system. This data is then all packaged into a csv file or files each evening for sending to the K2n platform

- Ensure air temperature and CO_2 sensors are provided for ALL main teaching spaces
- Ensure air temperatures are provided for Server Rooms and LAN rooms
- Provide Outside Air Temperature (OAT) sensors
- Ensure temperatures are recorded for key plant and circuits
- Choose a data collection and transmission system capable of collecting actual data at 15-minute intervals, storing this data, and automatically sending it to K2n in csv format via an email each evening at a specified time
- Ensure that an email server and external internet connection are available to the data collection and transmission system to be used

1.4.2.2 Sensors: Construction stage:

- Ensure OAT sensors are located where direct solar and indirect heating effects cannot affect the readings as these are essential to plant operation and assessment of heating/cooling performance in practice. This usually means using a Stevenson's screen located in a sheltered North facing area and above surfaces such as grass or a sedum roof.
- Locate CO2 and T sensors in the correct zones for each space
- Ensure all sensors have calibration certificates and their range is suitable for their use
- Ensure sensors are connected to the BEMS or other data collection and transmission device

BMS csv data file output for one day example

Note the data for each sensor should be the ACTUAL READING at each 15 minute interval, NOT an interpolation. This csv data should be sent each night via email to the unique email address given for the school once the final reading for the day has been taken and stored. This email address is of the form 'school_name_15min_data@data.k2nenergy.com'. The example file for one day shows data for just the first 8 sensors as examples, but all meter and sensor data could be in here too. Note that the column headings contain the BMS labels for each data stream

timestamp	HWS Calorifier Temp	HWS Flow Temp	HWS RTN Temp	HWS SECFlow Temp	HWS SECRTN Temp	LTHW Flow Temp	LTHW RTN Temp	Outside Air Temp	Etc for all meter and sensor points...
05/10/2020 00:00	65.1	79.8	75.5	79.8	61.2	79.9	71.1	11.3	
05/10/2020 00:15	64.4	78.7	77.8	78.7	58.8	80.4	61.7	11.2	
05/10/2020 00:30	64.9	77.2	76.4	77.2	55.2	80.8	62.6	11	
05/10/2020 00:45	65	75.9	75.2	75.9	52.8	80.6	61.8	10.8	
05/10/2020 01:00	65	74.7	74.1	74.7	51.8	80.1	62.2	10.8	
05/10/2020 01:15	65.1	73.5	73	73.5	50.2	80	62.2	10.8	
05/10/2020 01:30	65.1	72.4	71.9	72.4	48.5	80.7	62.1	10.9	
05/10/2020 01:45	65.1	71.3	70.9	71.3	48.2	80.2	63.4	10.9	
05/10/2020 02:00	64.9	70.2	69.8	70.2	49	80.2	63	11	
05/10/2020 02:15	64.9	69.2	69	69.2	48.6	80.6	62.4	11.1	
05/10/2020 02:30	64.9	68.4	68.2	68.4	48	80.6	62.5	11.1	
05/10/2020 02:45	64.9	67.5	67.3	67.5	47.6	79.8	61.5	11.1	
05/10/2020 03:00	64.8	66.7	66.5	66.7	46.9	80.1	62.4	11.2	
05/10/2020 03:15	64.7	65.8	65.7	65.8	47.4	79.9	63.1	11.4	
05/10/2020 03:30	64.7	65	64.9	65	47.2	80.1	62.6	11.5	
05/10/2020 03:45	64.6	64.2	64	64.2	47.5	80.7	63.1	11.6	
05/10/2020 04:00	64.4	63.4	63.2	63.4	47.2	80.4	62.7	11.8	
05/10/2020 04:15	64.3	62.6	62.4	62.6	46.5	79.8	62.5	12.1	
05/10/2020 04:30	64	61.8	61.5	61.8	46.9	79.7	63.3	12.2	
05/10/2020 04:45	63.8	61	60.7	61	46.8	80.1	63.6	12.5	
05/10/2020 05:00	63.4	60.2	59.9	60.2	46.5	80.4	63.9	12.7	
05/10/2020 05:15	63	59.5	59.3	59.5	46.1	80.4	63.9	12.9	
05/10/2020 05:30	62.5	59	58.7	59	46	79.6	64.3	13.2	
05/10/2020 05:45	62	58.4	58.1	58.4	46.3	79.6	64.1	13.4	
05/10/2020 06:00	61.5	57.8	57.5	57.8	46.3	79.5	63.5	13.5	
05/10/2020 06:15	61	57.2	57	57.2	46.3	79.9	63.4	13.8	
05/10/2020 06:30	60.5	56.6	56.4	56.6	46.3	79.7	63.7	13.9	
05/10/2020 06:45	60	56.1	55.8	56.1	46	79.9	64.3	14	
05/10/2020 07:00	59.5	55.5	55.2	55.5	45.4	80.3	64.1	14	
05/10/2020 07:15	59.1	54.9	54.6	54.9	44.9	80.4	63.6	14	
05/10/2020 07:30	58.7	54.4	54	54.4	45.9	80.4	63.5	13.9	
05/10/2020 07:45	58.4	53.8	53.2	53.8	46	80.4	63.3	13.9	
05/10/2020 08:00	58.1	53.2	52.2	53.2	46	80.3	64.4	13.9	
05/10/2020 08:15	57.7	52.7	51	52.7	45.6	80.4	64.3	13.9	
05/10/2020 08:30	57.4	52.2	50.1	52.2	45.3	80.3	63.9	14	
05/10/2020 08:45	57	51.6	49.5	51.6	45.2	80	63.8	14	
05/10/2020 09:00	56.7	51.1	49	51.1	44.4	80.3	64.4	14.1	
05/10/2020 09:15	49.9	60.3	57.6	60.3	47.8	60.4	55.2	14.4	
05/10/2020 09:30	58.2	82	74.7	82	52.8	82.2	71.9	14.6	
05/10/2020 09:45	62.1	74.9	71.4	74.9	55.4	75	69.8	14.9	
05/10/2020 10:00	65.8	78.1	75	78.1	58.6	77.8	74.2	15.3	
05/10/2020 10:15	66.5	76.9	73.9	76.9	61	77	71.7	15.6	
05/10/2020 10:30	67.4	78.5	75.2	78.5	63.1	78.9	72	15.8	
05/10/2020 10:45	67.4	78.5	75.2	78.5	63.1	78.9	72	15.8	
05/10/2020 11:00	66.5	80.8	80.2	80.8	63.5	80.9	74.2	16	
05/10/2020 11:15	64.6	80.4	80.3	80.4	62	80.6	73.6	16	
05/10/2020 11:30	62.9	76.6	72.4	76.6	60.1	76.1	70.9	16.3	
05/10/2020 11:45	64.1	78.3	73.4	78.3	59.7	78.6	70.9	16.6	
05/10/2020 12:00	65.9	78.5	74.6	78.5	61.1	78.7	72.7	16.9	
05/10/2020 12:15	66.3	80.3	76.3	80.3	62.2	80.6	73.6	17	
05/10/2020 12:30	65.6	80	76.5	80	62.3	80	73.6	17.3	
05/10/2020 12:45	64.3	79.9	77.7	79.9	61.5	79.9	74	17.6	
05/10/2020 13:00	64.2	77.4	73.6	77.4	60.5	77.7	71.2	18.1	
05/10/2020 13:15	65.1	79.5	75.2	79.5	60.7	79.7	72.9	18.3	
05/10/2020 13:30	65.6	79.1	75.4	79.1	61.5	79.2	72.8	17.7	
05/10/2020 13:45	65.4	80.1	76.1	80.1	61.8	80.2	73.4	17.2	
05/10/2020 14:00	64.9	79.9	76.2	79.9	61.6	80.4	72.5	17.1	
05/10/2020 14:15	64.7	79.4	75.3	79.4	61.1	79.4	72.7	17.5	
05/10/2020 14:30	64.9	80	75.7	80	61	80	73.7	18.5	
05/10/2020 14:45	65	77.5	74	77.5	61.3	78	71.6	17.2	
05/10/2020 15:00	65.1	78.2	74.5	78.2	61.4	78.3	70.6	14.3	
05/10/2020 15:15	65.1	75.2	72.6	75.2	61.5	75.4	66.3	13.5	
05/10/2020 15:30	64.8	81.8	76.8	81.8	61.3	82.3	69.8	13.3	
05/10/2020 15:45	65.1	76.4	73.3	76.4	61.4	76.8	69.5	13.2	
05/10/2020 16:00	65.1	79.2	75.4	79.2	61.3	79.2	71.6	13	
05/10/2020 16:15	65.1	79.4	75.5	79.4	61.5	79.7	71.2	13.2	
05/10/2020 16:30	65	78.9	75	78.9	61.3	78.9	71.4	13.1	
05/10/2020 16:45	64.9	79.3	75.4	79.3	61.3	79.5	71	12.8	
05/10/2020 17:00	65.1	78.7	75	78.7	61.3	78.8	71.1	12.8	
05/10/2020 17:15	64.9	78.6	74.8	78.6	61.2	78.7	71	12.8	
05/10/2020 17:30	63.9	67.4	66.3	67.4	61.1	69.3	57.7	12.5	
05/10/2020 17:45	65.4	80.9	76.1	80.9	60.7	81.3	70.7	12.4	
05/10/2020 18:00	66.1	79.1	75.9	79.1	62.1	77.1	70.7	12.4	
05/10/2020 18:15	65.3	77.7	74.5	77.7	62	78.3	67.8	12.4	
05/10/2020 18:30	64.7	78.5	75	78.5	61.4	78.4	69.3	12.4	
05/10/2020 18:45	64.4	77.2	73.6	77.2	60.9	77.3	68.3	12.3	
05/10/2020 19:00	64.7	76.7	73.3	76.7	60.9	76.8	68.3	12.3	
05/10/2020 19:15	65	76	72.9	76	61.2	76.2	67.8	12.2	
05/10/2020 19:30	65.5	79.1	75.3	79.1	61.5	79.2	70.2	11.9	
05/10/2020 19:45	65.4	79.5	75.7	79.5	61.8	79.7	70.4	11.7	
05/10/2020 20:00	65	80.5	76.6	80.5	61.6	80.6	71.1	11.6	
05/10/2020 20:15	64.7	79.4	75.6	79.4	61.3	79.8	69.8	11.5	
05/10/2020 20:30	64.8	79.5	75.3	79.5	61.1	79.4	70.8	11.4	
05/10/2020 20:45	65	79	75.2	79	61.2	79.2	70	11.4	
05/10/2020 21:00	65.2	79.9	75.9	79.9	61.4	80	70.9	11.4	
05/10/2020 21:15	65.2	79.5	75.6	79.5	61.5	79.5	70.8	11.4	
05/10/2020 21:30	64.9	80.3	76.2	80.3	61.4	80.4	70.8	11.3	
05/10/2020 21:45	64.8	80	75.9	80	61.2	80.3	70.4	11.3	
05/10/2020 22:00	64.9	78.9	75	78.9	61.2	79.1	70.2	11.3	
05/10/2020 22:15	65.1	79.7	75.7	79.7	61.3	79.8	70.8	11.2	
05/10/2020 22:30	65.1	79.7	75.8	79.7	61.4	80	70.6	11.2	
05/10/2020 22:45	65.1	79.4	75.5	79.4	61.4	79.5	70.7	11.2	
05/10/2020 23:00	64.9	79.6	75.7	79.6	61.4	79.8	70.1	11.2	
05/10/2020 23:15	64.9	79.7	75.7	79.7	61.2	79.8	70.6	11.2	
05/10/2020 23:30	65	79.2	75.3	79.2	61.3	79.3	70.5	11.1	
05/10/2020 23:45	65.1	79.7	75.8	79.7	61.3	79.9	70.7	11	

1.4.2.3 Sensors: Commissioning and operation stage:

- Ensure each sensor is correctly identified by the data collector
- Independently monitor the conditions being recorded at each sensor with calibrated instruments and check accuracy against recorded values at the data collector
- All sensors have their ACTUAL value recorded every 15 minutes. Do not use the interpolation setting which is designed to reduce space use in the BEMS database.
- Check the data is being sent each night after 00:00 and received at the K2n database

Example K2n Operational Data Input Table (Partial)

This table shows how the BMS Labels are used in the K2n asset sheet to connect the operational data to the right sensor

Name	Sensor Type	Unit Type	Unique Sensor Id (uses the labels from the csv file)
1st Floor Corridor Air Temp 1	Room air temperature sensor	Centigrade	1st Floor Temp1
1st Floor Corridor Air Temp 2	Room air temperature sensor	Centigrade	1st Floor Temp2
Kitchen AHU Supply Temp	Room supply temperature	Centigrade	AHU Supply Temp
CT Flow Temp	Hot water flow temperature	Centigrade	CT Flow Temp
CT Return Temp	Hot water return temperature	Centigrade	CT RTN Temp
Ground Floor Temp	Room air temperature sensor	Centigrade	Ground Floor Temp
HWS Calorifier Temp	Storage Temperature	Centigrade	HWS Calorifier Temp
HWS Flow Temp	Hot water flow temperature	Centigrade	HWS Flow Temp
HWS Return Temp	Hot water return temperature	Centigrade	HWS RTN Temp
HWS Secondary Flow Temp	Hot water flow temperature	Centigrade	HWS SECFlow Temp
HWS Secondary Return Temp	Hot water return temperature	Centigrade	HWS SECRTN Temp
LTHW Flow Temp	Hot water flow temperature	Centigrade	LTHW Flow Temp
LTHW Return Temp	Hot water return temperature	Centigrade	LTHW RTN Temp
Outside Air Temp	Outside Air Temperature	Centigrade	Outside Air Temp
VT Flow Temp	Hot water flow temperature	Centigrade	VT Flow Temp
VT Return Temp	Hot water return temperature	Centigrade	VT RTN Temp
Room 0021 Pupil Changing Temp	Room air temperature sensor	Centigrade	0021 Pupil Changing Temp
Room 0022 Sports Hall CO2	CO2	ppm	0022 SportsHall CO2
Room 0022 Sports Hall Temp	Room air temperature sensor	Centigrade	0022 SportsHall Temp
Room 0026 Dining Room CO2	CO2	ppm	0026 Dining RM CO2
Room 0026 Dining Room Temp	Room air temperature sensor	Centigrade	0026 Dining RM Temp
Room 0027 Kitchen CO2	CO2	ppm	0027 Kitchen RM CO2
Room 0032 Main Hall CO2	CO2	ppm	0032 MainHall CO2
Room 0032 Main Hall Temp	Room air temperature sensor	Centigrade	0032 MainHall Temp
Room 0042 YR6 Classroom CO2	CO2	ppm	0042 YR6 ClassRM CO2
Room 0042 YR6 Classroom Temp	Room air temperature sensor	Centigrade	0042 YR6 ClassRM Temp
Room 0047 Science Classroom CO2	CO2	ppm	0047 Science ClassRM CO2
Room 0047 Science Classroom Temp	Room air temperature sensor	Centigrade	0047 Science ClassRM Temp
Room 0051 Workshop CO2	CO2	ppm	0051 Workshop CO2
Room 0051 Workshop Temp	Room air temperature sensor	Centigrade	0051 Workshop Temp
Room 0054 Food Classroom CO2	CO2	ppm	0054 Food ClassRM CO2
Room 0054 Food Classroom Temp	Room air temperature sensor	Centigrade	0054 Food ClassRM Temp
Room 0057 ART Classroom CO2	CO2	ppm	0057 ART ClassRM CO2
Room 0057 ART Classroom Temp	Room air temperature sensor	Centigrade	0057 ART ClassRM Temp
Room 0065 ICT Classroom CO2	CO2	ppm	0065 ICT ClassRM CO2
Room 0065 ICT Classroom Temp	Room air temperature sensor	Centigrade	0065 ICT ClassRM Temp
Room 0068 General Classroom CO2	CO2	ppm	0068 GEN ClassRM CO2
Room 0068 General Classroom Temp	Room air temperature sensor	Centigrade	0068 GEN ClassRM Temp
Room 0071 Classroom CO2	CO2	ppm	0071 ClassRM CO2
Room 0071 General Classroom Temp	Room air temperature sensor	Centigrade	0071 GEN ClassRM Temp
Room 0074 Classroom CO2	CO2	ppm	0074 ClassRM CO2
Room 0074 General Classroom Temp	Room air temperature sensor	Centigrade	0074 GEN ClassRM Temp
Room 0080 General Classroom CO2	CO2	ppm	0080 GEN ClassRM CO2
Room 0080 General Classroom Temp	Room air temperature sensor	Centigrade	0080 GEN ClassRM Temp
Room 0083 General Classroom CO2	CO2	ppm	0083 GEN ClassRM CO2
Room 0083 General Classroom Temp	Room air temperature sensor	Centigrade	0083 GEN ClassRM Temp
Room 0086 General Classroom CO2	CO2	ppm	0086 GEN ClassRM CO2
Room 0086 General Classroom Temp	Room air temperature sensor	Centigrade	0086 GEN ClassRM Temp