Application Form: APPF:01

Application guide for entry of heat network performance data in SAP Products Characteristics Database

Issue 2.4

DOCUMENT REVISIONS

Documents will be revised by issue of updated editions or amendments. Revised documents will be posted on the website at www.ncm-pcdb.org.uk/sap.

Technical or other changes which affect product recognition requirements (for example) will result in a new issue. Minor or administrative changes (e.g. corrections of spelling and typographical errors, changes to address and copyright details, the addition of notes for clarification etc.) may be made as amendments.

The issue number will be given in decimal format with the integer part giving the issue number and the fractional part giving the number of amendments (e.g. Issue 3.2 indicates that the document is at Issue 3 with 2 amendments).

Users of this document should ensure that they possess the latest issue.

DOCUMENT REVISION LOG

DATE	VERSION NO.	AMENDMENT DETAILS
20.11.14	1.0	First issue
26.05.16	1.1	Amended Figure 1 & Table 1
14.12.21	2.0	DRAFT VERSION FOR COMMENT - Major update for use with SAP 10 – see introduction for details.
09.03.22	2.1	Updated in response to comments/review

10.05.2022	2.2	Updated in response to comments/review
06.06.2022	2.3	Updated in response to comments/review
12.07.2022	2.4	Final updates ahead of publication - Distribution losses

TABLE OF CONTENTS

1. INTRODUCTION

Building energy performance assessments are produced using the National Calculation Methodologies for energy rating buildings (NCMs). The NCMs are a range of assessment methodologies comprising the Standard Assessment Procedure for Energy Rating of Dwellings (SAP), Reduced Data SAP (RdSAP), which is used to assess existing dwellings, and the Simplified Building Energy Model (SBEM), which is used to assess non-domestic buildings.

Building energy assessment methodologies are used to deliver multiple Government policy initiatives. These range from Building Regulation compliance checks and the production of Energy Performance Certificates to supporting Energy Company Obligations (ECO) and other energy efficiency schemes by enabling the differentiation of improvements measures. Assessing the performance of a measure is complex and it may not always be possible to describe it in terms of a simple number for comparison purposes. In such instances the assessment of performance is only possible using building energy performance assessments that utilise specific product performance data.

In order to assess a building's energy performance, information is needed that describes the energy performance of the building fabric and building services. Such product performance data is either generic, determined by the materials and type of product used (‘type data’) or specific, where validated individual branded product performance data has been made available (‘product data’). Product performance data for the NCMs is normally held in the Product Characteristics Database (PCDB). The Building Research Establishment Ltd acts as the PCDB Administrator.

It is estimated that heat networks supply roughly 2% of the dwellings in the UK[1]. Local and central Government policy, particularly planning requirements and building regulation amendments, has resulted in many new-build dwellings being connected to heat networks for the provision of space heating and hot water services. For example, developers in

[1] Heat network experimental statistics, 2018

London committed to communal heat networks for 43,000 new-build dwellings in 2013 as part of approved strategic scale planning applications[2].

In view of the increased prevalence of heat networks and concerns regarding the generality of heat network default values in SAP, the SAP 2012 update enabled the entry of heat network data in the PCDB and this publication updates this system. The voluntary entry of heat network performance information in the PCDB assists SAP assessors in delivering robust assessments by using validated data. It also enables heat networks to enter specific values for their networks rather than using default values which might not be reflective of true performance.

This document provides updated guidance for the entry of heat network performance data in the PCDB by the Heat Network Operator[3], in particular the completion of the *"SAP PCDB Application Workbook for Heat Networks".*

[2] Monitoring the implementation of GLA planning policies in 2013, GLA July 2014

[3] The Heat Network Operator may be the Heat Network owner, or a suitably qualified organisation or individual appointed by them

2. SCOPE

2.1 Heat Network Definition

SAP 10.2 characterises heat networks '*as systems where heat is generated and supplied by a network and heat generation takes place outside of the dwellings it serves'*.

Heat networks comprise both district heating, where heat is distributed from a central source through a network to multiple buildings, and communal heating where heat is supplied within a single building to multiple occupants/dwellings.

In District Heating Systems the system can be split into 3 different elements as shown below: primary (distribution, often buried pipework, between the energy centre and the buildings), secondary (distribution within the building, risers and laterals up to the dwelling) and tertiary (within the dwelling pipework and radiators and hot water provision). Often in the UK, design of the system is such that there is hydraulic separation between these different elements (though it is possible to directly connect these elements without hydraulic separation except for DHW delivery).

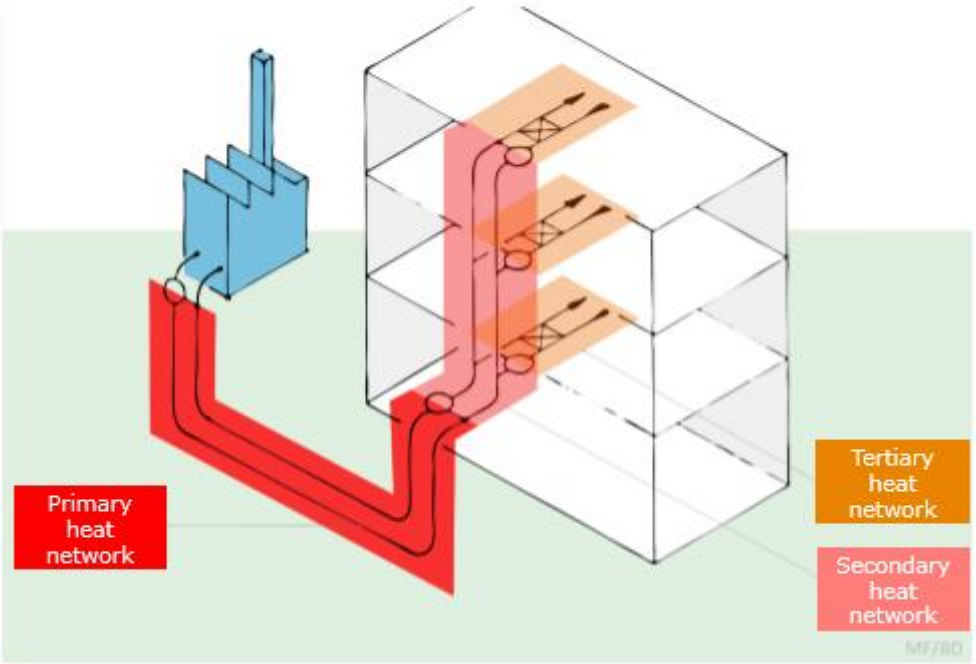


Figure 1 CIBSE CoP Schematic Showing Distinction between Primary, Secondary and Tertiary Elements of Heat Network

Ambient and Low Temperature Loops

There are increasingly complex arrangements which move away from an entirely centralised system. These are sometimes referred to as 5th Generation Heat Networks or Ambient Loops or Shared Ground Loops.

These may or may not warrant an entry in the PCDB. The following section categorises these systems and determines if the system should be entered in the PCDB.

1. **Ambient Loop without central heat source- heat pump within dwelling:**
   In this case heat pumps are sited within each dwelling and they extract heat from a loop which is balanced by an open or closed loop ground coupled system. Losses from pipework are zero or even negative and the only energetic input is pumping energy. In this case the system can be treated for the purposes of SAP as an individual heat pump system within the dwelling and **should be** entered into the Heat pump PCDB table and **need not be** entered into the Heat network PCDB table. Please contact SAP Appendix Q (sapq@bre.co.uk) for more details on getting this technology recognised in SAP.
2. **Centralised heat source with booster heat pumps within each dwelling:**
   In this case central plant exists (such as an air or water source heat pump) and heat is distributed at low, but higher than ambient, temperatures. Space heating within the dwelling may in this case be provided at the network distribution temperature or boosted, but DHW must be boosted by a distributed device, usually a heat pump. In such cases the heat network system **should be** entered in the PCDB.
3. **Hybrid systems with an ambient loop serving large central plant rooms, no heat pump in the dwelling**
   In this case an ambient temperature loop feeds centralised heat pumps serving higher temperature networks which feed dwellings. No boosting within the dwelling is required. The loop is generally balanced “passively” by groundwater coupling or may be balanced by cooling requirements or a combination. This system **should be** entered in the PCDB.

3. DATA ENTRY PROCESS

3.1 PCDB ENTRY PROCESS

Where the Heat Network Operator requires the entry of Heat Network performance data in the PCDB, they must follow the process defined below:

Step 1:

The Heat Network Operator wishing to enter Heat Network performance data in the PCDB, or amend an existing data entry, visits the Building Energy Performance Support Website: http://www.ncm-pcdb.org.uk/sap and downloads the *"SAP PCDB Application Workbook for Heat Networks"* and this document.

Step 2:

The Heat Network Operator collects the following heat network characteristics:

- List of connected buildings and monthly heat energy supplied to them
- Details of installed plant and existing metering
- Monthly heat energy supplied to the network and, where applicable, electricity generation figures
- Monthly fuel consumption for each fuel used

Where actual data is not available, nor the most appropriate, then estimates are acceptable (see further information in sections 3.3 and section 5)

Step 3:

The Heat Network Operator completes the *"SAP PCDB Application Workbook for Heat Networks"* and submits to sapproductlisting@bre.co.uk for review by the PCDB Administrator. The Heat Network Operator must ensure the latest workbook format is completed, which will be kept up-to-date. This workbook requires the following information:

- Background information on the heat network
- Details of any special fuels used (e.g. hydrogen, biomethane certificates, or other bespoke fuel sources including waste-wood biomass)
- Details of heat supplied to buildings (broken down by energy centre if appropriate)

- Annual energy input and output from the network (broken down by energy centre if appropriate)
- Information on heat generators
- Confirmation if estimated or actual energy consumption data has been provided

A performance timeline is given in section 3.2 below.

Step 4[4]:

The PCDB Administrator issues a proposal for data processing works and if acceptable to the Heat Network Operator the application proceeds to Step 5.

Step 5:

The PCDB Administrator reviews the application workbook, passing to BEIS for any clarifications or queries, and reports any missing or unsatisfactory data to the Heat Network Operator. Further clarification or evidence of performance claims may also be requested.

Step 6:

The Heat Network Operator resolves the issues highlighted in Step 5 and supplies a revised workbook, whilst ensuring that the workbook revision date is amended.

Note: Several iterations between steps 5 and 6 may occur in practice, but the proposal for data processing works will limit these iterations.

Step 7:

The PCDB Administrator confirms that the workbook has been accepted and requests that a "SAP PCDB Application Declaration for Heat Network by Heat Network Operator" form is signed by the Heat Network Operator.

A link to the SAP PCDB Application Declaration form can be found here.

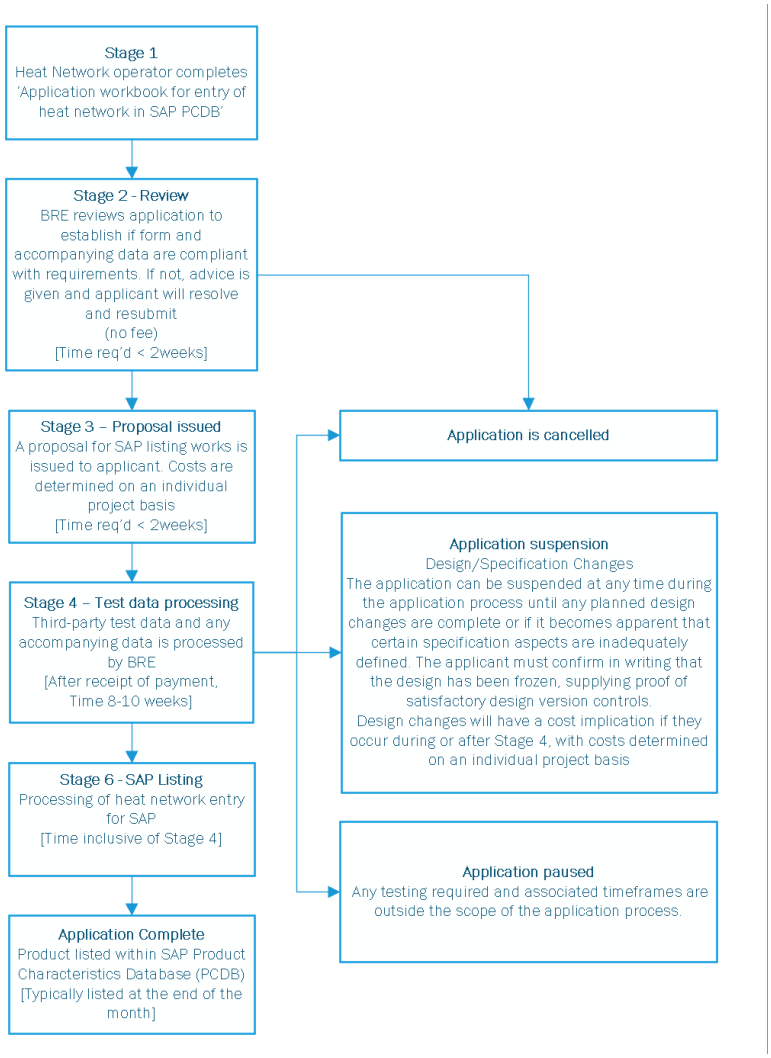
[4] This step is not applicable until further notice; data processing works required for applications will therefore not be chargeable.

Step 8:

The PCDB Administrator defines a Network Index Number and Version Number for the heat network PCDB data record, e.g. Index Number: 210000, Version Number: 01.

The PCDB Administrator uploads heat network performance data to the PCDB. The PCDB is updated monthly on the last working day of each month, excluding December where uploads typically occur on the 24th.

3.2 Process map of PCDB/SAP assessment:



BRE as administrators of SAP and the PCDB are committed to the above delivery timeframes as long as data is entered correctly. Any queries or requests for clarification will be returned by BRE in a timely manner to ensure applicants can upload entries as quickly as possible.

3.3 SAP entry process

The previous sections explained how heat networks should be entered into the PCDB and how that will interact with SAP assessment. This section gives a fuller overview of the SAP assessment process for heat networks.

Figure 2 (below) displays the process for inputting heat networks into SAP software.

Data for heat networks should be obtained from the PCDB where it is available. SAP assessors should be routinely checking the PCDB, or with the relevant heat Heat Network Operator/owner to ensure PCDB entries are being used, instead of relying on defaults.

For the purposes of SAP assessments, either design-stage or as-built, the network specific heat loss, expressed as a Distribution Loss Factor, can be determined using actual consumption data or estimated data and entered in the Product Characteristics Database (PCDB). It is expected that estimated data will be used for schemes that are planning to grow over many years and will not have actual metered data in the first few years of operation that reflect the project's long-term targets (further information is given in section 5.3.1 below). Where network heat losses are estimated for the purpose of PCDB entry, the DLF will include an in-use factor, although this is set equal to 1 for the interim.[5] Actual metered data is expected to be entered after 2 years, but at most after 5 years post-commissioning.

[5] In line with the 2019 consultation on Part L Building Regulations (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/852605/Future_Homes_Standard_2019_Consultation.pdf) we are removing the default IUF of 1.15 and keeping under review whether it will be appropriate to reintroduce an IUF based on new PCDB data. The IUF will be set equal to 1 for the interim and we do not expect to update it before the implementation of the Future Homes Standard in 2025.

For design-stage SAP assessments, a DLF and heat source information can be manually entered by the SAP assessor, but in line with SAP 10.2 this data should be obtained from the PCDB or the heat Heat Network Operator/owner where available. The entered DLF will require a suitable formal notification by the Property Developer to be supplied to the SAP assessor; this must confirm the design target DLF and confirm understanding that any shortfall may result in dwellings being non-compliant with Building Regulations at the as-built assessment stage.

For as-built SAP assessments, if DLFs are not entered via actual consumption data nor estimated through the PCDB a default DLF of 1.5 is applied if the heat network is designed and commissioned in accordance with the CIBSE/ADE '*Heat Networks: Code of Practice for the UK*'. This will require that the SAP assessor receives evidence via a certificate or headed letter from both the network designer and commissioning engineer, who have undergone competent persons training.

For either design-stage or as-built SAP assessments for new dwellings supplied by heat networks where none of the above methods have been used to enter a DLF, a default DLF of 2.0 is applied if the network is not designed and commissioned in accordance with the CIBSE/ADE '*Heat Networks: Code of Practice for the UK*'.

For undertaking RdSAP assessments of existing buildings, Distribution Loss Factors are determined by dwelling age, which is taken to relate to dwelling heat load and therefore implied network heat density.

Secondary Distribution Loss Factors

The PCDB splits distribution losses into primary and secondary losses. Primary losses are averaged across the core of the heat network whereas secondary losses are specific to the block connecting to the network. The calculation of losses in the PCDB should account for the primary losses on the network plus the secondary losses specific to the building being connected. Secondary losses on other previously connected buildings should not be taken into account in the overall losses.

The overall Distribution Loss Factor (DLF) that is ultimately entered into SAP after being entered into the PCDB is is calculated from Primary DLF x Secondary DLF.

For new connections to existing district heating systems there are three routes to establishing the secondary losses:

1. Bespoke: the building developers works with the Heat Heat Network Operator to understand what likely secondary losses will be and this is developed as a bespoke calculation. The Heat Heat Network Operator enters the specific block name, heat demand and secondary losses into the PCDB. The SAP assessor looks up the Heat Network and then the specific block name from the PCDB entry for that Heat Network.

2. Proactive-bespoke: The Heat Heat Network Operator can submit evidence through the PCDB to be given a bespoke default secondary losses. This can be done ahead of any connections to buildings are negotiated. These secondary losses will then be specific to new buildings connecting to that network and SAP assessors will simply select “new connection” from the PCDB entry for that Heat Network if they’re considering connecting to that network. Evidence will required from the Heat Network such as a specification setting secondary loss levels for new connections.

3. A general default “new connection” will be set in the PCDB for any entry which will be the same across all PCDB HN entries. This will be generic for heat networks. This can be used by the SAP assessor for any new connection to a heat network in the absence of 1 or 2.

   The value for this default Secondary DLF is 1.18 reflecting a value of 15% heat loss.

These three options are available for a Design Stage SAP assessment. For an As Built SAP assessment, only Option 1 will be available – otherwise the original default overall DLFs of 1.5 and 2.0 will be applied.

A Note on Distribution Loss Factor Definitions

Whilst the PCDB itself differentiates between Primary and Secondary Losses, ultimately these are combined into an overall DLF for SAP purposes. These are defined below

- Secondary DLF = (Dwelling Demand + Secondary Losses) / Dwelling Demand
- Primary DLF = (Dwelling Demand + Secondary Losses + Primary Losses)/ (Dwelling Demand + Secondary Losses)
- Overall DLF = Primary DLF x Secondary DLF

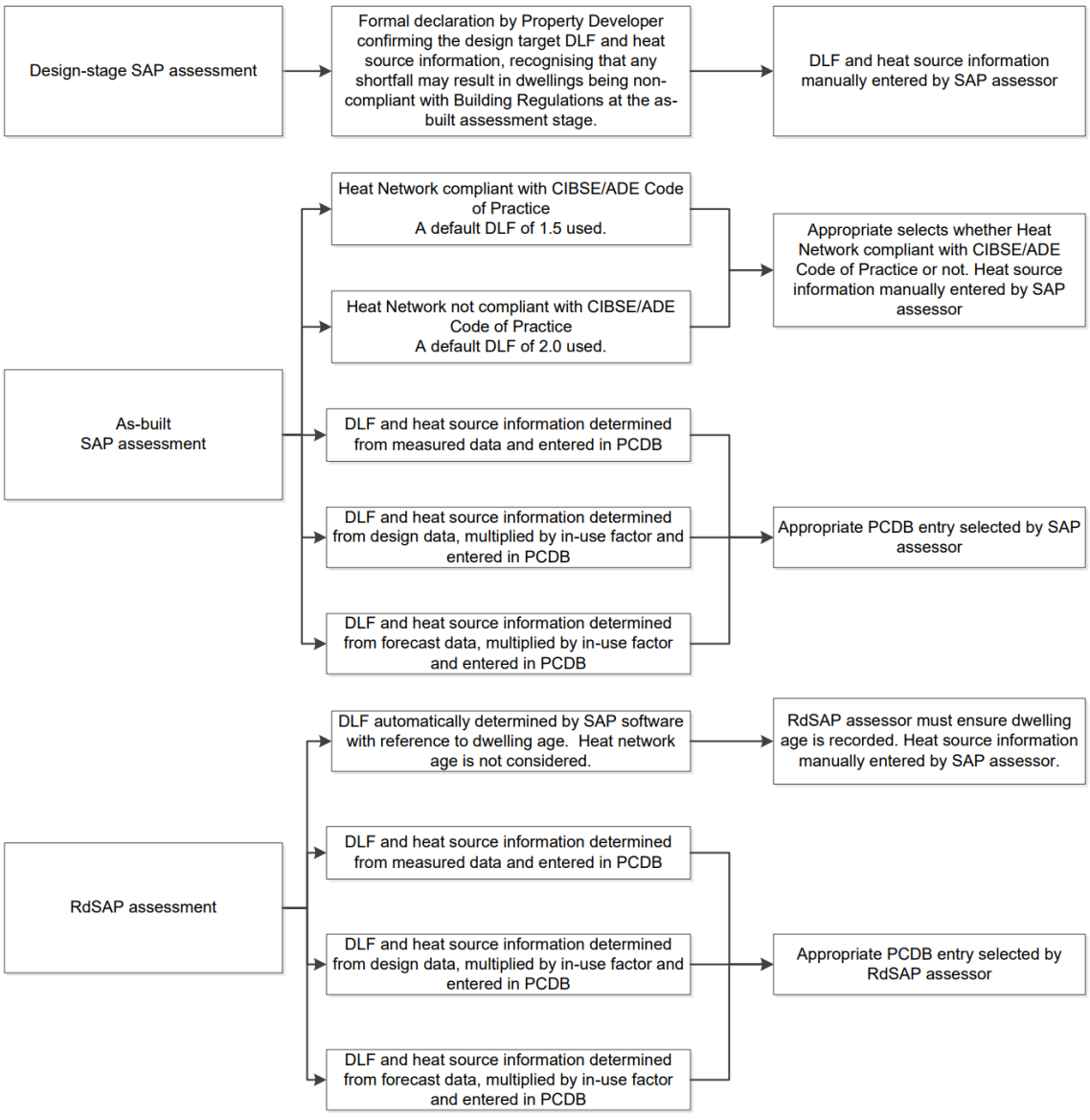


Figure 2- SAP Heat network input process

3.4 Role and responsibilities

This PCDB application guidance is intended to enable heat Heat Network Operators and SAP assessors to use the updated PCDB functionality for heat networks as part of SAP to produce the Building Regulations England Part L (BREL) report required by the Part L Building Regulations Approved Document.

Part L of Building Regulations requires The Buildings Regulations England Part L (BREL) report and photographic evidence should be provided to the building control body and to the building owner to show that building work complies with energy efficiency requirements.

The Building Regulations Part L Approved Document requires the Building Control Body to be notified before work starts of compliance with the Target Primary Energy Rate and the Target Dwelling Emission Rate. This is referred to as the 'design' stage in this document.

Once work is complete the Building Control Body must be notified with an 'as-built' assessment. The as-built BREL report should be signed by the person carrying out the SAP assessment to confirm that the as-built calculations are accurate and that the supporting documentary evidence and photographs have been reviewed.

The as-built BREL report should be signed by the building developer to confirm that the dwelling has been constructed or completed according to the specifications in the report

The person carrying out the SAP assessment should use PCDB entries for the heat network if available to ensure that unnecessary use of default values is avoided.

The SAP administrator ('BRE') is responsible to running the PCDB and accepting and examining applications in line with the process laid out in section 3.2.

The Department for Business Energy and Industrial Strategy (BEIS) appoints the SAP administrator and is responsible for SAP and the PCDB.

3.5 Due to general heat network modification

It is recognised that heat networks may change over time. SAP assessments should always be done with the most up-to-date performance data for the heat network. In addition significant changes, such as those defined below, must be reported by the Heat Network Operator to the PCDB Administrator in accordance with the "PCDB data entry process for Heat Networks" defined above even when new connections to buildings are not being made.

Updates to the PCDB entries will ensure that new EPCs are issued with the latest performance data of the network. It will also ensure that government and BRE are able to assess whether forecasted changes to heat networks are completed.

Amendments of the heat network performance data will not trigger changes to EPCs of dwellings connected to the heat networks.

Changes to the heat network PCDB data record will result in the Version Number being incremented. Changes requiring PCDB Administrator notification and incremented Version Number include:

- Modification to heat network size[6], e.g. when a new phase is added to a new build development
- Addition, removal or renewal[7] of a heat generator, e.g. CHP, biomass boiler
- New energy demand and/or supply data becomes available, e.g. actual data to replace estimated data

The process for modifying a heat network PCDB data record is shown in Figure 3 below.

[6] Where the heat consumption changes by +/- 10% as a result of dwellings and non-domestic buildings being added or removed from the heat network.

[7] Where the renewal is not a like for like replacement

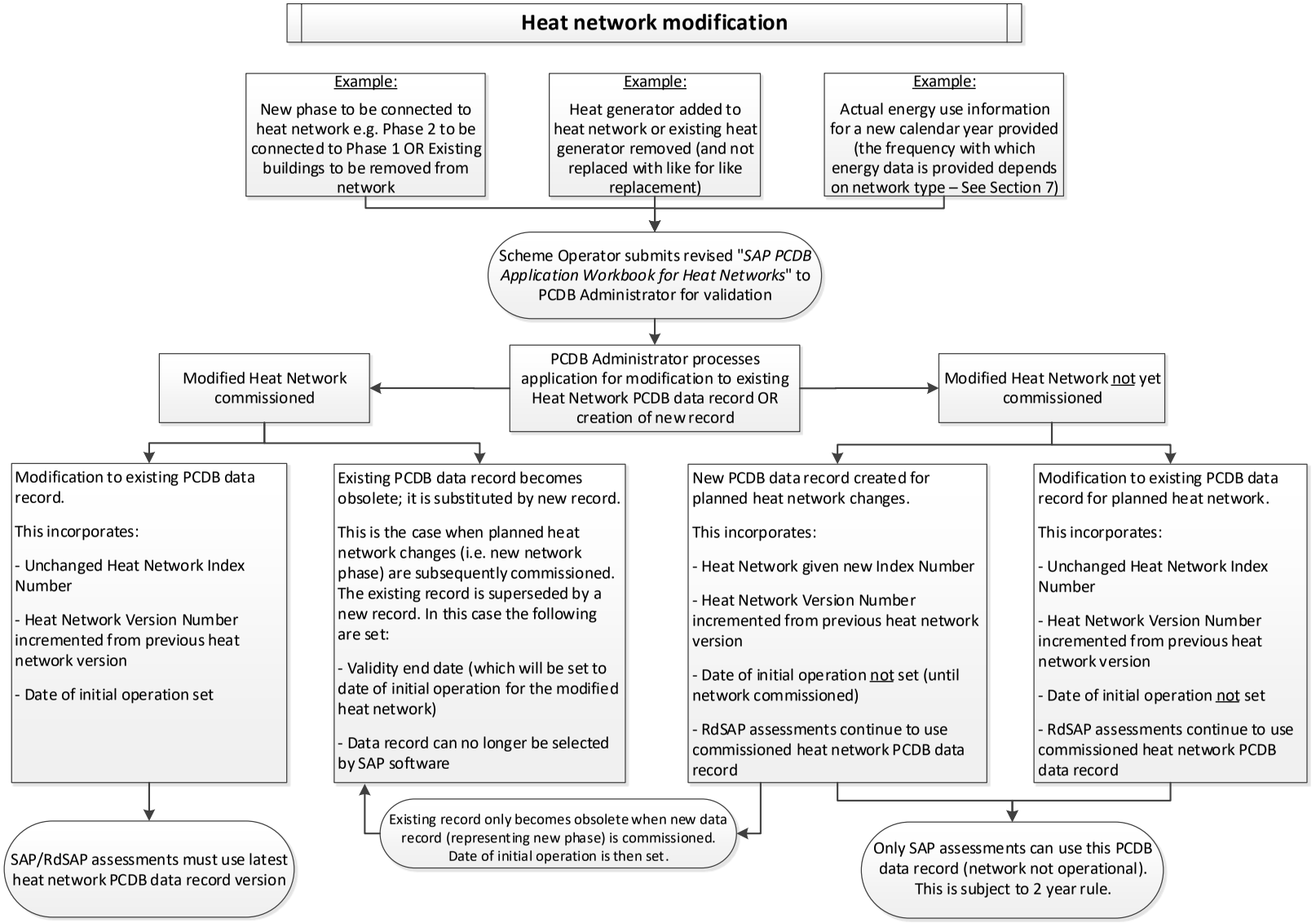


Figure 3 - Heat Network PCDB data record modification process

3.6 Due to new network construction phases

Heat networks, particularly those serving new residential developments, are often designed and built in multiple phases. Such phasing may extend over a long period of time.

SAP assessments are required at varying stages of a dwelling's life, specifically:

- To demonstrate compliance with Building Regulations at the 'as-designed' and 'as-built' stages (an Energy Performance Certificate (EPC) is produced at the as-built stage)
- To generate energy performance certificates (EPC) at lease or sale (and after the previous EPC has expired)

SAP assessors may be required to undertake assessments for groups of planned dwellings where the planned dwellings will be served through the extension of an existing heat network constructed to serve existing dwellings (e.g. Phase 1 of a Heat Network). In this case, the PCDB heat network data record must be based on the combined energy inputs and outputs for both the planned and existing dwellings.

In line with the Building Regulations Part L Approved Document where new generators are added in later phrases to a heat network, this will affect all dwellings connected to the heat network. This means that if a "low carbon" heat generator has been installed this will provide some CO_2 benefit to the entire network. Alternatively, if a "higher carbon" heat generator has been installed this will have some CO_2 penalty on the entire network.

4. APPLICATION TECHNICAL GUIDANCE

Technical details must be entered in the *"SAP PCDB Application Workbook for Heat Networks"* and supplied to the PCDB Administrator in order to process a PCDB data entry or amendment. The applicant Heat Network Operator must enter all required data in all worksheets of the workbook as below:

- Worksheet 1: Background information
- Worksheet 2: Special Fuels
- Worksheet 3: 'Heat supplied' to customers
- Worksheet 4: 'Energy Centre' energy inputs and outputs

Details must only be entered in the yellow cells. Note that multiple Heat Supplied and Energy Centre worksheets may be automatically generated depending on answers to questions on the Background information worksheet

Results are shown in the Summary and Overall Summary Sheets. Overall Summary combines results from multiple energy centre Summary sheets if they exist.

The Heat Network Operator must separately develop and maintain a system to monitor and assess the performance of their heat network.

Note: All energy information must be provided on a gross calorific value (GCV) basis and relate to a complete year.

The sub-sections below provide further information on the specific requirements of the Worksheets.

4.1 Worksheet 1: Background information

The Heat Network Operator must supply background heat network information for administration purposes, which includes:

- Heat network index number (only to be provided if heat network entered in PCDB previously)

- Previous version number (only to be provided if heat network entered in PCDB previously)
- Network name e.g. Trafford Estate Heat Network.
- Address of the primary energy centre
- Postcode of the primary energy centre
- Heat Network Operator (applicant) details:
    - Organisation name
    - Contact person
    - Contact person's telephone number
    - Contact person's email address

The Heat Network Operator (applicant) must provide evidence via a declaration that they are entitled to make representations on heat network performance on behalf of the owner.

The second element of the background information relates to the broad characteristics of the network and includes the following:

- A brief description of the network (maximum 255 characters). Where the network is serving multiple phases of a new build development, this must identify which phases are included and whether each phase is planned or existing.
- The length of the heat distribution network in metres, which is the trench length plus any internal distribution route within apartment block risers and laterals
- The date of initial operation, which is the date the energy centre(s) commenced supplying heat to all dwellings connected to that network phase. If the network phase is only planned then this field must be left blank.
- The network status, for example:
    - Existing network
    - Existing network plus planned new extension
    - New network
- Network service provision: Whether the network will supply heat for
    - Space heating and domestic hot water
    - Domestic hot water only
    - Space heating only
- Number of energy centres
- Whether all energy centres can supply all heat demands.

Note that if multiple energy centres exist and the network architecture is such that energy centres supply specific customers - which might be the case in hybrid ambient loop style system – then multiple Heat Supplied and Energy Centre worksheets are automatically created.

4.2 Worksheet 2: Special Fuels

Special Fuels

Emissions factors are included in this workbook for the standard list of fuels shown in Table 12 of the current version of SAP Specification. Hydrogen, Green Gas Certificates, waste-wood biomass and others are exceptions and so if these are to be used then assessors must enter factors within this sheet for both CO_2 and PE intensity. Please provide separate justification for these values and the PCDB administration body (Building Research Establishment Ltd) and the Department for Business Energy and Industrial Strategy (BEIS) will review entries before approval. Further guidance on how these applications will be assessed will be published early in 2022.

4.3 Worksheet 3: Heat supplied

An important aspect of the PCDB data entry process is determining the amount of heat supplied to the connected buildings. This is measured at the interface between the heat network and the building, i.e. the system boundary extends to the building connection, thereby enabling the effect of heat losses in the heat network to be accounted. Note: In the case of apartment blocks, it is the heat supplied to individual dwellings within the apartment block.

This worksheet requires that the Heat Network Operator lists the connected buildings, or those to be connected, and provides an indication of each building's scale e.g. number of dwellings in each apartment block or floor area for each non-domestic building.

For each building the monthly heat supplied to dwellings and/or non-domestic buildings in each calendar month must be provided. Prior to providing the data for each building, the applicant is required to confirm:

1. Whether the building is existing, under construction or planned

2. Whether the building is already connected to the heat network or to be connected in future
3. Whether the data is based on meter readings or estimated

The user must state the calendar year to which the information relates, which must be the most recent full calendar year.

The information provided by the applicant will be used by the PCDB administrator to establish:

- Total number of dwellings including the total number of flats
- Total number of existing dwellings
- Total non-domestic floor area included

4.3.1 Heat supplied to dwellings and non-domestic buildings

Long Term Distribution Loss Factor

The PCDB adopts the terminology used in the CIBSE/ADE Heat Networks Code of Practice and requires the user to provide data split into primary and secondary network heat losses. In this workbook primary losses are calculated as the difference between heat demand at building level including secondary losses and the heat generated as detailed on the Energy Centre(s) tab. The calculated primary distribution loss factor is then displayed on the Summary and Overall Summary tabs.

The primary distribution loss factor = Heat Generated/Building Level Demand including secondary losses.

Whilst the user will need to calculate or meter the primary losses, they do not generally need to be explicitly entered into the workbook. As highlighted in section 3.2 an exception is where a significant change in primary distribution loss factor isexpected over the lifetime of the heat network. In this case the user should enter a value into the long-term primary distribution loss factor cell at the top of the Heat Supplied sheet. This value will then be used in the PCDB instead of the calculated value - though both values will be stored in the PCDB and enable users of the PCDB to monitor progress towards the long-term value. An obvious example of the need for a long-term primary distribution loss factor is where

the primary pipework connecting initial phase of a network has been significantly oversized to supply future phases.

Secondary losses - which relate to the pipework within the thermal envelope of a block of flats up to the dwelling boundary – should be entered on this sheet in terms of W/dwelling for apartment blocks. This, and the number of dwellings in the block, are used to calculate a secondary loss factor which is specific to the block. For houses or non-domestic buildings it is assumed that no secondary loss factor applies.

Calculation of Losses

For existing networks and dwellings, losses should be calculated from metered data (except where it is more appropriate to use the long-term values described above).
For new heat networks or extensions to existing heat networks it will not be possible to enter data from existing meters.

There are 2 options to estimate losses associated with the new networks or extensions to existing networks:

1. Use of the Heat Loss Calculator. This can be found at the following link: www.heatlosscalculator.carbondescent.org.uk. This will calculate primary and secondary losses. Pipe data can be uploaded from an Excel workbook.
2. At the as-built stage data can be extrapolated from acceptance testing. If data is provided from this approach then the methodology used to extrapolate from the acceptance test should be detailed and provided separately to the workbook. This extrapolation can be based on forecasts of the development of the heat network scheme to bring it closer to the long-term value described above.

Heat Demands

Domestic

Heat demands should be entered in MWh at a monthly level even if the annual profiling is an estimate. This is necessary because SAP 10.2 has been updated in line with industry feedback to require some primary energy and emission factors to be specified at a monthly level.

Heat supplied to dwellings and non-domestic buildings should be metered and recorded though it is understood that some older properties may not have individual heat metering.

For apartment blocks with communal heating systems, the monthly domestic heat supplied to the apartments within the block, expressed in MWh, must be entered into the worksheet. As described above secondary losses should be entered in W/dwelling. The demand figures in MWh should be the total block monthly MWh excluding the secondary losses.

If applicable, the heat supplied to other types of dwelling, e.g. terraced houses, in each calendar month must also be determined and entered. In each case, the Heat Network Operator must indicate if the monthly heat supplied figures are based on actual metered data or estimated. The worksheet calculates the total domestic annual heat supplied.

At design or as-built stage meter reading data will not be available, and the Heat Network Operator will need to estimate the heat consumption data for dwellings as an interim measure. SAP 10, which uses local weather data to estimate space heating requirements, must be used to estimate the heat consumption of individual dwellings. Where dwellings are of the same type and characteristics, a modelled dwelling can be used to represent other dwellings. For example, a number of representative apartments could be used to estimate the heat consumption of all dwellings within an apartment block.

Non-domestic

As with dwellings, for each connected non-domestic building the heat supplied in each calendar month must be determined and entered. Non-domestic buildings, given their scale and commercial independence, invariably have individual heat meters. Therefore, it is expected that actual heat metered consumption will be provided for existing buildings served by existing networks.

Where actual metered data is not available, for example where a non-domestic building is under construction, the monthly heat consumption must be estimated based on modelling

using SBEM[8] or a dynamic building simulation tool certified to produce EPCs. These models provide space heating and hot water consumption on a kWh/m^2 basis, which can be used to derive the monthly MWh consumption figures required.

4.3.2 Correcting meter readings to calendar year

Meter reading data must relate to a whole calendar year. Where meter readings are not available for the entire calendar year corrections must be applied.

Additionally, it is important for January and December to ensure only heat consumed within the calendar year under consideration are included. Where necessary, a similar process must be adopted for other months. For example, where the opening heat meter readings were taken on 27 December of the preceding year and again on 31st January (a period of 35 days), the January (31 days) heat consumption figures would be adjusted accordingly, i.e. kWh / 35 *31.

4.4 Worksheet 3: Energy centre(s)

Heat Generators

This worksheet first requires the user to enter data about the number of each type of heat generators within the energy centre in question (or energy centres if all heat generators in separate energy centres can supply all heat loads). Information must be provided on all heat generators used to generate heat for the network, i.e. the system boundary encompasses the whole heat generation system, not individual heat generators.

In line with the approach specified in Approved Document L1 2021 when calculating the dwelling primary energy rate and dwelling emission rate for a dwelling connected to a new district heat network, the calculation should be made as if the heat network is connected to a heat source to be used up to 31 December 2027. In this way, any planned transition of the heat network to an alternative means of heat generation will be properly accounted for. When there will be a change in heat source up to 31 December

[8] Simplified Building Energy Model, which is the UK National Calculation Methodology for energy rating of non-domestic buildings

2027, a submission to the building control body should be made to show both of the following.

A. That planning permission, if required, has been granted for the change.

b. That the heat network will connect to the new source, with confirmation in the form of a signed contract to connect and supply heat.

Long Term Average Values

Many larger networks will be negotiating a large number of potential connections every year. This makes the process of adding new data to the PCDB quite onerous. Each additional connection will change the energy supplied by each type of plant. We have therefore allowed the HN operator to use long term average values for the energy centre plant mix. The energy centre plant mix is the relative contribution of different sources of generation that are already installed at the point of assessment (or for new networks before 31st December 2027, as explained above).

The workbook should be used to calculate these values initially. Once the values have been established, they should be entered at the top of the Energy Centre(s) EC1 worksheet (and EC2 etc if there are multiple and they supply heat loads separately). The workbook will use these values if they are >0, instead of calculated values. Please note that if long term average values for the energy centre plant mix are used, then the user must also use a long-term average primary distribution loss factor entered on the Heat Supplied EC1 sheet.

Heat Generator categories

Heat generators have been split into 4 different categories.

- CHP (see 5.4.1 below)
- Heat Pump (see 5.4.2 below)
- Heat Recovered without Heat Pump, including EfW (see 5.4.3 below)
- Boiler Plant (see 5.4.4 below)

The dropdown allows the user to add up to 5 of each type. If there are more than 5 heat generators of a specific type then additional generators should be combined into a single entry as appropriate. For example, boiler plant grouped together according to efficiency or fuel.

For CHP it's important to separate CHP by age, as the CO_2 emission factor and PE factor for electricity varies according to the age of the CHP. The reason for this is that older CHP

will have less lifetime remaining and its operational lifetime will have been during a period with higher grid carbon intensity.

Heat Recovered without Heat Pump covers a range of technologies for instance:

- Heat Recovered from EFW CHP
- Heat Recovered from Geothermal or other natural sources
- High grade heat recovery
- Low grade heat recovery
- Heat Recovered from Power Stations

The definition of these categories can be found in the most recent SAP update: https://www.bregroup.com/sap/sap10/?cn-reloaded=1.

Please note that reducing the number of any generator type will wipe any data entered on the Energy Centre(s) sheet associated with the heat generators that are removed. For instance, if the user had originally selected 3 CHPs and entered data on the Energy Centre(s) sheet for all 3 CHPs and the user returns to Heat Generators and changes the number of CHPs to 2, then the entered data will be deleted for CHP 3.
The rest of the energy centre worksheet requires the Heat Network Operator to enter information relating to the energy inputs to and outputs from heat generators already defined in the energy centre.

For each energy input and output, the user is required to indicate whether the figures are based on actual metered or estimated data. The worksheet includes provision for notes in relation to inputs within that row. As above in section 5.3.2 we acknowledge that for some heat network schemes target efficiencies are not met in the first years of operation and this extends to the efficiency of plant generation as well as the proportional contribution of each generator in the portfolio of generators. Where a user enters estimated efficiency and generation mix this should be indicated in the PCDB entry and actual metered data is expected to be entered after 2 years but at most after 5 years post-commissioning.

Where elements of the fuel consumption data are estimated, the Heat Heat Network Operator will first determine the heat network's monthly heat energy requirement. This energy requirement will be the sum of total heat consumption of the dwellings and non-

domestic buildings and heat losses from the network. Appendix 1 provides further information, whilst Appendix 2 provides guidance on the determination of distribution loss factors where data is estimated.

Apportioning combined gas consumption data

If, due to installed metering, gas consumption data is only available for the combined consumption of the energy centre, the gas consumption must be approximately apportioned to the different gas using heat generators, e.g. CHP, boilers. The heat network's monthly heat load profile and the heat efficiency of the individual heat generators must be used to apportion the fuel.

4.4.1 Combined Heat and Power

For heat networks supplied with heat from a Combined Heat and Power plant (CHP), the Heat Network Operator must enter:

- Monthly heat supplied to the network
- Monthly electricity generated
- Monthly fuel consumed in MWh

In the case of operational CHP equipment, each of these parameters should be available from the monthly operating report provided by the CHP supplier – this is an automated report routinely produced by small-scale CHP suppliers.

For the avoidance of doubt, the monthly heat supplied is the useful heat supplied to the network, i.e. excluding any heat dumped in a heat rejection facility. For each energy input and output, the Heat Network Operator must confirm that the figures are based on actual metered data.

Estimating data

Where actual CHP data is not available and estimates must be made, the text below provides guidance on how this must be approached.

Where CHP is proposed it will usually:

- be the lead heat generator,
- supply the majority of the heat required by the network, and

- operate on regular days and times throughout the year

The monthly heat supplied to the network from CHP must be estimated by accounting for hours run in each calendar month, heat output from CHP and any heat rejected (where applicable). Reference must be made to the monthly heat load profile generated from design calculations and the Heat Network Operator's own predictions.

The monthly electricity generated by the CHP must be specified. For CHP units with no heat rejection facility, the electricity output broadly equates to the monthly heat supplied to the network divided by the maximum heat to power ratio. For many CHP units with no heat rejection facility, the maximum heat to power ratio is provided in the Combined Heat & Power Quality Assurance (CHPQA) Programme (https://www.gov.uk/combined-heat-power-quality-assurance-programme) unit list[9]. Otherwise, the ratio must be obtained from the manufacturer's data sheet. For CHP units with a heat rejection facility, the heat to power ratio must be the heat efficiency (based on useful heat) divided by the power efficiency, which can vary according to operation.

The CHP fuel type and monthly fuel consumption must be specified. This will equate to the monthly heat supplied to the network by the CHP divided by the CHP heat efficiency (based on gross CV or higher heating value (HHV). For CHP units with no integrated heat rejection facility, the heat efficiency for many CHP units is stated in the CHPQA unit list[10]. For CHP units with a heat rejection facility, the heat efficiency must account for the useful heat supplied to the network, i.e. any heat rejected must be subtracted from the CHP heat output. Note: If estimated energy use is provided it is not necessary to provide the volume of gas consumed.

4.4.2 Heat Pumps

Where the heat network heat generator is a heat pump or group of heat pumps, the Heat Network Operator must enter:

- Monthly heat production in MWh

[9] https://www.chpqa.com/guidance_notes/CHPQA_UNIT_LIST.pdf

[10] https://www.chpqa.com/guidance_notes/CHPQA_UNIT_LIST.pdf

- Monthly electricity consumption in MWh

Low grade heat recovery

Heat networks recovering low grade heat from processes which would have happened regardless of the heat being recovered (i.e. while carrying out some other necessary process), and which require additional energy input to elevate the temperature of the heat transfer medium, should select the heat pump option to determine CO2 and Primary Energy emissions.

Where 2 or more stages of heat pumps are used in series these should be entered here in a consolidated format as if they were a single heat pump. The entry for heat supplied in each month should be the heat output of the final stage of the heat pumps. The entry for energy supplied in each month would be the total electricity input to all heat pumps at every stage. An exception to this would where the heat pump providing the lower temperature heat is a chiller (ie it provides useful cooling to a cooling system.) In this case the electricity into the chiller may be allocated to the cooling demand and the electricity into heat pump interfacing the heat demand directly should be allocated to the heat demand. Where a single heat pump provides heating and cooling simultaneously without the use of boosting by a second heat pump, the electricity input should be shared between heating and cooling based on the Total Energy Ratio (TER). For example, if the input to the heat pump is 1MW of electricity and the output in heat is 4MW for heat and simultaneously 3MW of cooling, the TER = (4+3)/1 = 7. If the heat pump generates 20,000MWh of useful heat annually, then the electricity allocated to heat would be 20,000/7= 2,857MWh.

Energy for circulation pumps and source pumps may be included in the electricity input or the pumping energy section at the bottom of the sheet as appropriate.

Note that this process should also apply even where the final stage of heat pump is located within the dwelling.

For this purpose, ‘low grade heat’ means heat which requires additional energy input to elevate temperature. Examples of recovered heat sources in this category include heat

from: data centre cooling; refrigeration processes; sewage treatment and wastewater processing; substation heat rejection.

4.4.3 Heat Recovered without Heat Pumps

Where the heat network heat generator is recovered without the use of a heat pump, the Heat Network Operator must enter:

- The Heat Recovery type
- Monthly heat production in MWh

And also select an appropriate category for CO2 and PE emission factors. Available heat recovery types categories in SAP 10.2 are:

- Heat Recovered from EFW
- Heat Recovered from Power Stations
- Heat Recovered from Geothermal or other natural sources
- Heat Recovered from Other High-grade Processes

Heat recovered from EfW

This specifically refers to Energy from Waste facilities where the primary purpose of the plant is to dispose of municipal or commercial waste. High-grade heat can be recovered for district heating from the power generation process. This category allows for EfW plants below 30MWe to be included.

Heat recovered from power stations

This specifically relates to plants where the primary purpose is to generate electricity defined as plants rated at more than 30MWe, unless they fall into the Heat Recovered from EfW category above.

Heat recovered from geothermal or other natural sources

This category relates to instances where natural/ambient heat can be recovered. Examples include solar thermal heat. High- or low-grade heat can be recovered for district heating.

Heat Recovered from Other High-Grade Processes

Heat networks recovering high grade heat from processes which would have happened regardless of the heat being recovered (i.e. while carrying some other necessary process), can be considered to be free in terms of CO2 and Primary Energy, subject to any additional energy required to facilitate the recovery of that heat (e.g. pumping energy). For this purpose, 'high grade heat' means heat which requires no additional energy input to elevate temperature before delivery to a heat network. The CO2 emission and Primary Energy factors in Table 12 for heat networks using 'high grade heat recovery' are used, which include an allowance for the electricity used for pumping the water from the heat source. For low grade heat recovery options requiring heat pumps to raise the temperature please see the section above.

4.4.4 Boilers

Where the heat network heat generator is a boiler or group of boilers using the same fuel, the Heat Network Operator must enter:

- Monthly fuel consumption in MWh
- Monthly heat generated in MWh

The Heat Network Operator must confirm whether figures are based on actual metered data, or are estimated.

Where solid fuel (e.g. biomass) is specified, the monthly fuel consumed must be determined with reference to the fuel characteristics. The mass of dry fuel must be determined by subtracting the element of the wet fuel's mass due to moisture. For example, for a moisture content of 30% by weight the wet fuel mass would be multiplied by 0.7, i.e. (100 – 30)/100. The dry fuel mass is then multiplied by the dry gross calorific value of the fuel to provide the energy input on a gross calorific value basis. The dry gross calorific value of the biomass must be obtained from the fuel suppler. The volume of solid fuel consumed must not be reported, but the mass of the fuel (on a dry and wet basis) and the calculations used to derive the energy content of the fuel must be provided (as an additional attachment).

<u>Estimated data</u>

The efficiency of the boiler(s) must be determined in accordance with Appendix C2 of SAP2012. The monthly fuel consumed must then be determined by dividing the total heat supplied to the network by the boiler(s), whether assumed or metered, by the boiler efficiency.

4.4.5 Electricity used by circulation pumps

Heat networks use pumps to circulate primary water through distribution pipes and supply heat energy to dwellings and non-domestic buildings. The electrical energy consumption of these pumps must be recorded in Worksheet 3.

Where circulation pumps are sub-metered the actual metered consumption must be provided. Where metered data is not available, the electricity consumption must be estimated by accounting for the characteristics of the pump(s) e.g. rated power, operating hours, etc.

For the avoidance of doubt, this electricity consumption does not include that used by circulation pumps within dwellings and non-domestic buildings.

4.4.6 Converting flow meter readings to energy

Heat and electricity meters will normally provide readings in kWh or MWh, however, gas meters will usually provide the volume of gas consumed. This volume must be corrected for actual temperature and pressure then converted to energy using the calorific value of the gas. The assumptions used for calculation of energy from gas consumed must be provided.

Similarly meters recording the liquid fuel used by a heat generator will normally report in litres. This value must be converted to MWh using the calorific value of the liquid fuel.

5. DATA PROCESSING FOR PCDB DATA ENTRY

The purpose of the PCDB Administrator processing data supplied by the Heat Network Operator in the *"SAP PCDB Application Workbook for Heat Networks"* is to validate the following parameters for data entry in the PCDB:

- Distribution loss factor
- Pumping electrical energy
- Heat generator type(s)
- Heat generator fuel for each generator
- Heat efficiency for each heat generator
- Heat Fraction for each heat generator
- Electrical efficiency for Combined Heat & Power unit(s) (if applicable)
- Heat Fraction for Combined Heat & Power unit(s) (if applicable)

A number of other parameters are also recorded in the PCDB, see "APPENDIX 1 - PCDB HEAT NETWORK DATA FORMAT".

Using the methodology defined in the current SAP specification, the validated performance characteristics of the heat network will be used to establish the following for heat supplied to connected dwellings and non-domestic buildings:

- Carbon dioxide emission factor
- Primary energy factor

6. PCDB RECORD MAINTENANCE REQUIREMENTS

An application for entry of Heat Network performance data in the PCDB may initially be based entirely or partially on estimated data supplied by the Heat Network Operator. It is important to provide actual metered heat consumption data as soon as possible after a scheme has reached maturity. This should generally be done within two years of the heat network commissioning date. Where it is not appropriate to provide actual meter data the project can notify that the project intends to continue to use its long-term estimated factors, in order to maintain the PCDB data entry and it can continue to do this for up to five years. If either of these are not supplied after two years of the project commissioning the PCDB data record validity end date will be set at the second anniversary of the commissioning date. From this date SAP assessments using the PCDB record will no longer be possible unless either a notification is made to BRE that the project intends to continue using estimated data or actual metered data is provided.

Note: Each dwelling and non-domestic building (and any other system consuming heat supplied by the heat network) should be metered in line with the Government's Heat Networks (Metering and Billing) Regulations[11].

6.1 Frequency of data provision

Upon receipt of the *"SAP PCDB Application Workbook for Heat Networks"* from the Heat Network Operator the PCDB Administrator will review and process the application and may request further details/data and any necessary workbook revision iterations. Once the workbook is accepted by the PCDB Administrator, a validity period for the data record will be applied. This depends on a number of factors influencing the seasonal performance of the heat network.

For example, the environmental performance of a small heat network supplying dwellings from a central gas boiler is unlikely to change significantly from year to year. In comparison, a large multi-user heat network connected to a range of heat generator types may vary considerably, with factors such as relative fuel costs influencing operation.

[11] https://www.legislation.gov.uk/uksi/2020/1221/contents/made

Table 1 defines the validity period for Heat Network PCDB data entries, this includes metered systems where heat supply, fuel consumption and, where applicable, electricity generation data is provided.

	Type	**Validity period**
1	Heat network only connected to 1 heat generator, e.g. central boiler(s) using same fuel. Data record based on metered data.	7 years
2	Heat network connected to 2 heat generators, e.g. CHP and top-up boilers OR heat pump and gas boilers. Data record based on metered data.	3 years
3	Heat network connected to 3 or more heat generators, e.g. CHP, heat pump and gas boilers. Data record based on metered data.	2 years
4	Heat network data record based on design data and/or long-term forecast factors	2 years (from commissioning date)[12]

Table 1 – Data record validity period for heat networks in PCDB

[12] Actual metered data is expected to be entered after a maximum of 5 years post-commissioning

7. AUDITING

Heat networks listed in the PCDB will be subject to random technical audit at any time, subject to three weeks' notice being given by the PCDB Administrator, see: *"Terms and Conditions applicable to the listing of individual branded product performance data as an input to the National Calculation Methodologies for dwellings"* at: www.ncm-pcdb.org.uk/sap. This will include site visits to ensure data submitted by the Heat Network Operator corresponds with the actual network. If the heat network has entered estimated data for the distribution loss factors or the estimated efficiency of the heat generator then the site visit will seek reaffirmation and explanation of the target figures and seek assurance of when the heat network will submit actual data.

In December 2021 the government committed to regulating the heat network sector with Ofgem appointed as the heat networks regulator with responsibility for ensuring that heat networks meet minimum technical standards for operation and that they meet their Net-Zero targets for decarbonisation. As Ofgem takes on greater responsibilities in this area the PCDB administrator and Ofgem will cooperate and share information on the operation of networks entered in the PCDB to ensure that the estimated data in the PCDB is credible.

During the desk-based element of the audit the Heat Network Operator will be required to:

- Confirm the heat generators connected to the heat network and the details relating to:
  - Heat generator type
  - Fuel used by each heat generator
  - Heat and, where applicable, electrical power output capacity
- Confirm the metering is in place to monitor the fuel inputs and heat and electrical outputs from heat generators connected to the heat network. For each meter the following will be confirmed:
  - Metered service, e.g. natural gas, heat, electricity
  - Description of the metered service: examples of this include:
    - Natural gas supply to the energy centre
    - Natural gas supply to the top up boilers
    - Natural gas supply to the CHP
    - Total heat supplied to the heat network

- Total heat supplied by CHP
- Electricity generated by the CHP

  - Year of meter installation
  - Model/type of metering
  - Serial number of the meter
  - Measurement units of the meter e.g. m^3, MWh.
  - Date of calibration from the calibration certificate
- Provide a diagram showing the metering arrangements in relation to the heat generator(s)
- Confirm the heat metering method in the dwellings and non-domestic buildings
- Explain how the energy input and output data provided in the final revision of the *"SAP PCDB Application Workbook for Heat Networks"*, accepted by PCDB Administrator, was derived from meter readings

During the site visit the audit will confirm the connection of heat generators and fuel type, and also consider any issues arising from the desk-based element of the audit, e.g. the configuration and operation of any heat rejection equipment connected to the CHP.

Applicants must maintain clear and accurate records that support their Heat Network PCDB data record. Therefore, it is essential that appropriate metering is installed and monitored.

Finally, entries in the Products Characteristics Database for heat networks are publicly available at an aggregated data level. For information on the level of data published you can visit the website here to see previous entries. If consumers or other companies are concerned about the accuracy of the entry for a heat network they can contact BRE at sap2012@bre.co.uk or BEIS at heatnetworks@beis.gov.uk

2

APPENDIX 1 - PCDB HEAT NETWORK DATA FORMAT

Data from the fields marked X in the second column are needed when carrying out a calculation to the SAP 10.2 specification.

FORMAT 602 (for Heat Networks Table)			
Field	X	Field name	Description
1		Community heat network index number (6 digits)	Unique index number for each network, assigned automatically by database software and used for control and reference purposes.
2	X	Community heat network version number (2 digits)	Network version for the network identified in field 1. It is numbered from 1 upwards and incremented if the network is extended and when equipment data is amended (for example a change to a heat generator) or if the energy use information is updated.
3	X	Status (one digit)	Status of the data record, encoded as 0=normal status for an actual product, 1=illustrative (non-existent) product, 2=under investigation, 3=not valid, 4=methodology under review.
4		DB entry updated (yyyy/mmm/dd hh:mm)	Date and time this record was created or last amended by the database administrator.
5		Community heat network name (up to 50 chs.)	The name by which the community heat network is known.
6		Description of network (up to 255 chs)	A short description identifying the dwellings to which the network version applies. Where the network is constructed in phases this may also indicate which phases are connected.
7	X	Validity end date (yyyy/mmm/dd)	The last day of validity of this data record. Dwellings assessed after this date use a data record with a higher network version number (in the case of new dwellings the applicable assessment date is that of the as-designed assessment). Blank if there is no record with a higher network version number.
8		Postcode of the Primary Energy Centre (up to 8 chs)	The postcode of the energy centre providing heat for the network. Where there is more than one energy centre, it is the postcode for the energy centre supplying the largest amount of heat
9	X	Service provision (1 digit)	Service provision, encoded as: 1 space and water heating; 3 space heating only; 4 water heating only. If a network has separate systems for space heating and water heating, there will be a record for each.
10	X	Data source (1 digit)	Whether the record represents provisional (estimated) data, actual recorded data or forecast data, encoded as 1,2 and 3 respectively. Provisional data may be assigned to new networks for which recorded data are not yet available.
11	X	Year (up to 4 digits)	The calendar year to which the data relates. Blank if provisional data.
12	X	Number of sub-heat networks (up to 7 digits)	The total number of sub-heat networks included in the assessment of this heat network.
13	X	A: Sub-heat network name	The name by which the sub community heat network is known.

		(up to 50 chs.)	
14	X	A: Distribution loss factor (up to 4 chs, e.g. x.xx)	Factor that allows for losses from the heat distribution network. Applicable to all connected premises.
15	X	A: Pumping electrical energy per sub-heat network (up to 6 digits, e.g. xxxx.xx)	Annual electrical energy for pumping in the heat distribution network attributed to each sub-heat network, in kWh/year.
16	X	A: Pumping energy factor (up to 4 chs, e.g. x.xx)	Electrical energy used for pumping as fraction of heat energy supplied, attributed to each sub-heat network. Blank if unknown.
17	X	A: Carbon dioxide intensity of heat (up to 6 digits e.g. xx.xxx)	The average carbon dioxide intensity of the heat delivered to customers. in kg/kWh. This value takes into account all factors which influence the emissions associated with the heat supplied.
18	X	A: Primary energy factor of heat up to 5 digits e.g. xx.xx)	The average primary energy factor of the heat delivered to customers. This value takes into account all factors which influence the primary energy associated with the heat supplied.
19	X	A: Cost of heat (up to 8 digits e.g xxxxx.xx)	The cost of the heat delivered to customers. This value takes into account all factors which influence the cost associated with the heat supplied.
20 to 13+7n	X	Group B, C, D, E..etc	Group B, C, D, E…etc. Set of data in the same format as those for group A for other blocks. n is the value in field 12.