Specification: SPEC:05

SAP New Technology recognition – Review decision logic

Issue 1.0.1

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

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1. INTRODUCTION

The Standard Assessment Procedure (SAP) is the UK's National Calculation Methodology for energy rating of dwellings. It is used for many policy purposes, including the production of Energy Performance Certificates (EPCs) and for Building Regulation compliance.

SAP assesses the performance of all fixed elements of a dwelling, including building services equipment, such as boilers and mechanical ventilation. It does not consider the performance of non-fixed appliances, such as fridges.

SAP assessments are supported by two databases that hold in-use performance data for products which impact the energy performance of a dwelling. This data is provided by manufacturers on a declaration basis, typically via test data, that is processed into a different form using a calculation method that represents typical operation in UK homes.

The principal database used by SAP assessment software is known as the Product Characteristics Database (PCDB). The PCDB holds performance information for technology types that were known prior to the publication of the latest version of the SAP specification, which is generally updated every 3 to 5 years. These technology types have established calculation and testing methodologies which are used when entering data into the PCDB. Data from the PCDB is easy for SAP assessors to use because it is read automatically by SAP software.

In some cases, the SAP recognition of a New Technology type is required, and this cannot be implemented via the PCDB, normally because the request arises in-between SAP specification updates. In this case, an alternative database is used, known as the Appendix Q database. This database works as an adjunct to SAP assessment software, converting performance data into an energy or CO2 emission saving value that is entered within software.

2. REVIEW DECISION PROCESS

When assessing the prospects for recognising a New Technology within SAP assessments, it is necessary to perform a consistent and logical evaluation. To that end, the following decision diagram displays the process undertaken. The diagram includes numbered links to explanatory notes, and alphabetic links to actual examples of technology types that have been recognised by this process.

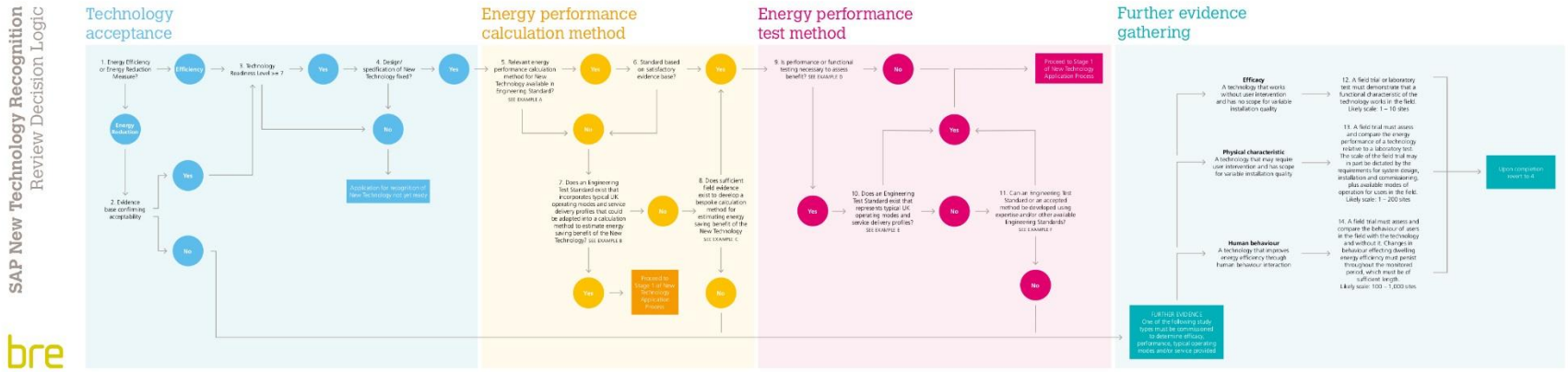

Figure 1 - Review Decision Logic diagram[1]

[1] Larger version available on the PCDB website (http://www.ncm-pcdb.org.uk/sap/page.jsp?id=20)

2.1 EXPLANATORY NOTES

The following notes relate to numbered items within the above diagram.

2.1.1 TECHNOLOGY ACCEPTANCE

1) Energy Efficiency vs Energy Reduction Measures

Energy Efficiency Measures are defined as those that provide the same level of building service whilst reducing dwelling energy use. For example, a condensing boiler enables the same level of heating service to be provided with less energy than a non-condensing boiler.

Energy Reduction Measures are defined as measures that change the service experienced by occupants in a way that maintains their comfort while reducing energy consumption. For example, a temperature controller may allow a heating system to adjust internal temperatures below standard SAP assumptions.

2) Energy Reduction Measures – Evidence confirming acceptability

In some cases, New Technologies reduce domestic energy consumption by changing the service experienced by occupants in a way that maintains their comfort. Where evidence demonstrates that occupants are unaware of this service change, or are satisfied with it, the technology can be recognised by SAP. Refer to “Further evidence gathering” section.

3) Technology Readiness Level (TRL)

Technology Readiness Levels are an indication of the maturity stage of development of a particular technology on its way to being developed for a particular application or product. The table below provides some broad titles for TRLs[2]:

TRL	Title
1	Basic research
2	Applied research
3	Proof of technical concept
4	Lab and Test Bench Demonstrations
5	Development Prototypes
6	Engineering or Demonstration Prototype
7	Operational Prototype (Alpha Product)
8	Production Prototype (saleable Beta product)
9	Marketable Product

4) Status of New Technology design and/or specification

New Technologies applying for recognition within SAP must be TRL 7 or above, with a performance specification that has been fixed. This is because an effective analysis of a technology's performance cannot be undertaken if that performance remains subject to fundamental change, e.g. the modes of operation of a particular technology could continue to change as control logic evolves during TRL 7, where the New Technology is at Operational Prototype stage.

[2] Further definitions can be found at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/722140/FINAL_EEF_7_Guidance_Document.pdf and https://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2016_2017/annexes/h2020-wp1617-annex-g-trl_en.pdf

2.1.2 ENERGY PERFORMANCE CALCULATION METHOD

Developing a calculation method that estimates the energy savings provided by the New Technology for recognition by SAP

5) Energy performance calculation method available in Engineering Standard?

Ideally, a suitable Engineering Standard[3] is published by a national or international engineering standards body (not necessarily UK) which provides a suitable calculation method for estimating the energy performance of the New Technology.

6) Reviewing evidence base of calculation method available in Engineering Standard

The NCM (SAP) Contractor is responsible for maintaining and developing SAP. This role is currently undertaken by the Building Research Establishment (BRE) on behalf of the Department for Business, Energy and Industrial Strategy (BEIS).

To ensure that any calculation method within an Engineering Standard is acceptable for analysing the energy performance of a New Technology within UK dwellings, BRE will conduct a review. The review will ensure that variables such as typical operating modes, service delivery profiles and installation arrangements[4] are satisfactorily represented – see Example A. An accepted calculation method would subsequently be recognised by the SAP specification, typically via supplementary documentation.

[3] Engineering standards are documents that specify characteristics and technical details that must be met by the products, systems and processes that the standards cover. In the case of an energy performance calculation method within an engineering standard, this will include specifying the procedure and data inputs required.

[4] In some cases, a technology may be installed in a range of scenarios, e.g. a heat pump may be connected to heat emitters of varying heat output for a given inlet water temperature, affecting the heat pump's performance. All such scenarios must be understood and, if appropriate, recognised by SAP.

7) Adapting Engineering Test Standards for the purpose of a calculation method

In the absence of an Engineering Standard that features an acceptable calculation method for analysing the energy performance of a New Technology, it may be possible to adapt an Engineering Test Standard[5] as the basis of a calculation method, using the operating modes and service delivery profiles specified in the standard.

The Engineering Test Standard should be published by a national or international engineering standards body (not necessarily UK) and provide a defensible and robust representation of typical UK operation. The standard must also consider typical installation arrangements for the New Technology when installed in UK dwellings.

In such cases, BRE would review available standards and the appropriateness of their use. See Example B. Any method subsequently developed would be integrated within the SAP specification, typically via supplementary documentation.

8) Sufficient field evidence for development of a bespoke calculation method

In some cases, field evidence is available that demonstrates typical operating modes, service delivery profiles, installation arrangements and energy performance for a New Technology. In such cases, BRE may develop, from scratch, a calculation method for analysing the energy performance of the New Technology within UK dwellings – see Example C. Any method subsequently developed would eventually be integrated within the SAP specification, typically via supplementary documentation.

[5] Some Engineering Standards are test method specifications. Physical tests are one type of test that are regularly used in science or engineering. The method is a definitive procedure that produces a robust test result. To ensure accurate and relevant test results, the test method should be explicit, unambiguous, and experimentally feasible, as well as effective and reproducible.

2.1.3 ENERGY PERFORMANCE TEST METHOD

If required by the calculation method, developing a test method for assessing the operational performance of a New Technology for recognition by SAP

9) Is testing of the New Technology required?

For certain types of New Technology, the characterisation of operation and/or performance may not require testing for the purpose of analysing its energy performance within UK dwellings. For example, a simple control device that performs a particular simple function; also see Example D.

10) Is a suitable Engineering Test Standard available?

In cases where the characterisation of a New Technology's operation and/or performance requires testing for the purpose of analysing the energy performance of the New Technology within UK dwellings, BRE will conduct a review of available Engineering Test Standards.

The review will ensure that variables such as typical operating modes, service delivery profiles and installation arrangements are satisfactorily represented – see Example E. An accepted test method would subsequently be integrated within the SAP specification, typically via supplementary documentation.

11) Developing an Engineering Test Standard or an accepted test method

In cases where an Engineering Test Standard is unavailable, it may be possible to develop a test standard, either by utilising existing knowledge and test methods or by consultation with relevant experts – see Example F. In other cases, the development of a test method specifically for SAP recognition purposes is more practical – see Example G.

2.1.4 FURTHER EVIDENCE GATHERING

In cases where insufficient data is available to characterise the operation of a New Technology within UK dwellings, and its effect on energy performance, it is necessary to commission a study to determine efficacy, typical operating modes and/or service provided by the New Technology. The study must be scientifically robust and sufficiently independent of commercial bias. This is to ensure claims made by manufacturers are accurate and to fairly reflect these in SAP.

There are three types of further evidence gathering exercises (12 to 14):

12) Efficacy assessment – Demonstrating a New Technology works as described

"A New Technology that works without user intervention and has no scope for variable installation quality"

This evidence gathering exercise is the simplest and requires demonstration, either via field demonstration in a dwelling or laboratory test, that a relevant characteristic of the New Technology works as intended. In most cases, a single test or demonstration site will be sufficient.

An illustrative example: see Example D.

13) Physical property – Establishing the sensitivity of energy performance estimation for a New Technology

"A technology that may require user intervention and has scope for variable installation quality"

This evidence gathering exercise is required for New Technologies whose installed energy performance is sensitive to installation variables and/or user intervention. For this reason, a reliable estimation of a New Technology's energy performance cannot be assured by laboratory test data alone.

Field evidence of the variation in New Technology's installed performance relative to laboratory test data is required. In most cases, an "in-use factor" or range of factors are

derived in order to downgrade laboratory measurements and better represent real-world performance.

The scale of the field trial may in part be dictated by the requirements for system design, installation and commissioning, plus available modes of operation for users in the field. In most cases, the number of trial sites required to provide statistically significant conclusions will range from 1 to 200. Unfortunately, it is impossible to provide a narrower indicative range because the required sample size will depend on both the magnitude of the technology's benefit and the variance of the results, which are technology specific.

A real example: see Example H.

14) Human behaviour – Establishing how the New Technology interacts with varying human behaviour

"A technology that improves energy efficiency through human behaviour interaction"

This evidence gathering exercise is required for New Technologies whose installed energy performance is reliant on particular assumptions with regards the behaviour of dwelling occupants.

The field trial must assess and compare the behaviour of users in the field with the technology and without it. Changes in behaviour effecting dwelling energy efficiency must persist throughout the monitored period, which must be of sufficient length to show benefits last beyond any initial period of novelty-driven occupant interest. The trial period may also need to account for variable weather conditions, so would generally be at least 6 months and encompass some or all winter months. In most cases, the number of trial sites will range from 100 to 1,000 sites. This number is generally higher than that for technologies which do not depend on human behaviour, which is inherently variable.

An illustrative example: see Example I.

2.2 NEW TECHNOLOGY RECOGNITION EXAMPLES

EXAMPLE A

In 2016, available test data for space heating heat pumps changed as a consequence of Ecodesign regulations (No. 811/2013 and 813/2013) being launched. The new test method was the Engineering Standard EN14825. This necessitated a change to the energy performance calculation method used by SAP.

The new test method (EN14825) also incorporates a calculation method for estimating the energy performance of heat pumps. BRE conducted a review[6] of this method and confirmed it was unacceptable for SAP purposes[7], so a new method (DAHPSE – Domestic Annual Heat Pump System Efficiency) was developed, based on Engineering Standard EN15316-4-2 – a performance calculation method developed in support of the EU's Energy Performance of Buildings Directive.

EXAMPLE B

Waste water heat recovery systems (WWHRS) can be fitted to showers to allow heat from the waste water flowing out of a shower to be recovered. This heat is used to preheat water to the shower itself or to the dwelling's heating system. These systems can be used with or without a store. In this case, a Dutch Engineering Test Standard (NEN 7120) was used to form the basis of the energy performance calculation for WWHRS.

EXAMPLE C

In 2013, BRE finalised a bespoke energy performance calculation method for recognising a novel type of solar-assisted heat pump system. This comprised a large solar thermal

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[6] An overview can be found here: https://www.bre.co.uk/filelibrary/heatpumptool/Home-Truths-article---Heat-pumps.pdf

[7] Reasons include: No consideration of Plant Size Ratio (PSR) – the heat output of the heat pump relative to the dwelling heat loss; no consideration of supplementary heating; no consideration of hot water heating; no consideration of intermittent heating; no consideration of cases where weather compensation absent; no consideration of UK weather conditions.

collector array, two large thermal stores (installed outside) and a water-to-water heat pump.

Whilst an energy performance calculation method existed for heat pumps, it was necessary to characterise the number and type of operating modes for the wider system. As a consequence of the characteristics of the solar thermal collector design, it was necessary to perform EN12975-2 tests on its performance in an external environment. For this reason, it was decided that by performing tests outdoors, it would be possible to simultaneously monitor and characterise the number and type of operating modes (with the heat pump inactive).

The resultant energy performance calculation method was developed with reference to observed operating modes and utilised EN12975-2 (solar collector) test data and EN14511 (heat pump) test data.

EXAMPLE D

An illustrative example: Waste Water Heat Recovery Systems (WWHRS) are not recognised within the SAP calculation when connected to electric showers. This is because, unlike non-electric showers, the WWHRS would lead to an increased water flow rate from a standard electric shower, not an energy saving. If an electric shower and WWHRS product package were available that prevented variation in water flow rate, maintaining a flow rate consistent with the counterfactual scenario, it could be recognised. In this case, the demonstration of an acceptable (New Technology) control mechanism that satisfied this requirement would be sufficient.

EXAMPLE E

An example of an Engineering Test Standard that satisfactorily incorporates typical operating modes, service delivery profiles and installation arrangements for UK dwellings is EN13203-2 – a method for measuring the hot water performance of a combination boiler.

The method incorporates a 24-hour schedule for the consumption of hot water energy at different times of day and, when using 'Load Profile M', satisfactorily represents the energy consumed by average UK dwellings and the notional effect of real use.

EXAMPLE F

In 2008, the Publicly Available Standard Engineering Test Standard - PAS 67:2008 – "Laboratory tests to determine the heating and electrical performance of heat-led micro-cogeneration packages primarily intended for heating dwellings" was published. This standard was developed through a collaboration that included Government, Industry and BRE.

Development of this standard was driven by the requirement to recognise the energy performance of micro-cogeneration packages within dwellings. Shortly after publication of the standard, an energy performance calculation method was developed for SAP. This utilised the test method and assumption framework in PAS67:2008 to enable the recognition of micro-generation (or "mCHP") packages.

Example G

In 2011, BRE developed a test method to assess the energy performance of Dynamic Insulation (a New Technology). This method adapted the test method ISO 8990 through the introduction of an accurately controlled and measured airflow rate at a specified temperature. Tests were conducted on product samples at the National Physical Laboratory (NPL) and these validated theoretical predictions provided by the manufacturer.

A calculation method and tool were then developed to enable "dynamic" U-values to be input within SAP assessment software.

Example H

Mechanical Ventilation and Heat Recovery was recognised in SAP as a New Technology in 2008 (via Appendix Q). This recognition included the development of a test method representing common installation practices in compliance with Building Regulations. As part of this recognition, a field trial was commissioned by the Energy Saving Trust comprising 36 dwelling installations. Resultant findings informed in-use factors that were incorporated into SAP's recognition of the technology.

Example I

A manufacturer has developed a novel type of space heating controller that incorporates an algorithm that systematically lowers the average temperature setpoint without affecting dwelling occupant comfort - An Energy Reduction Measure.

A suitable field trial is designed on the basis of a statistical assessment and subsequently commissioned. It incorporates 280 trial sites without the controller and 280 sites with the controller, both featuring identical measurement and logging equipment. These sites comprise a suitably representative range of dwelling and occupant types. The field trial is completed once the necessary monitoring period has elapsed, as specified by the field trial design.

Upon completion of the field trial and suitable analysis of data, results demonstrate that energy savings have been acceptably demonstrated and an application to Stage 1 of the New Technology Application Process is made.