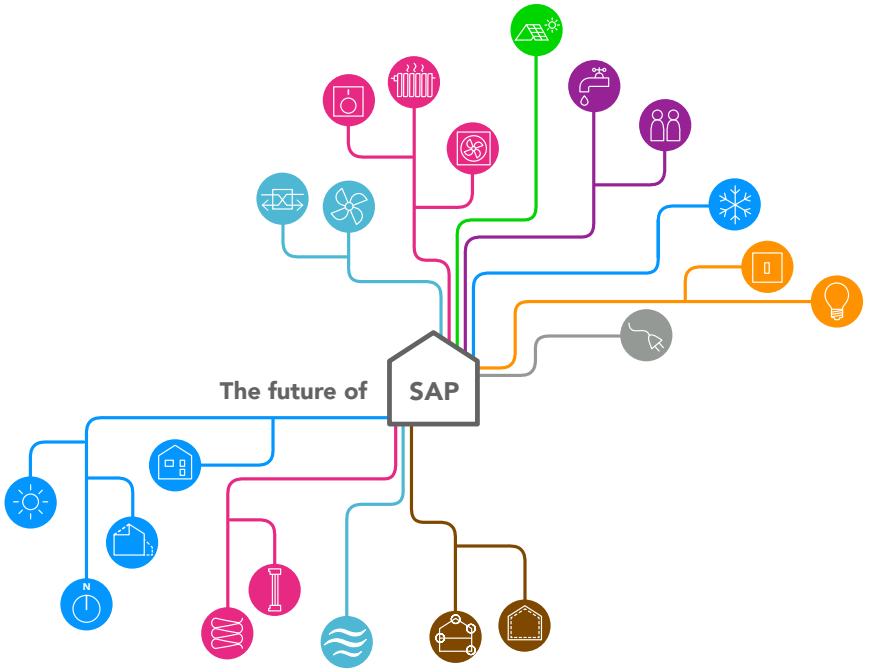
Making SAP and RdSAP 11 fit for Net Zero | 15-minute summary



A report for the Department for Business, Energy and Industrial Strategy

June 2021 | Rev K

Etude

CIBSE

Levitt Bernstein
People.Design

ELEMENTA

WSP

CLARION HOUSING GROUP

UCL

Our methodology

Principles

Our work, undertaken during the COVID-19 pandemic (Aug 2020-Jan 2021), adopted the following key principles to address the ambitious brief set out by BEIS. It was clear that our work should not just focus on which algorithms in the SAP / RdSAP methodology should be changed:

- Being **open minded**: approaching the review with as wide a scope as possible to consider all options, from only minor improvements to a complete re-think.
- **Learning** from experts, past experience, the literature and from what is being done across the world for energy modelling of domestic buildings.
- Being as **evidence-based** as possible and highlighting gaps or differing opinions.
- Taking account of and expressing the **view of SAP /RdSAP users**.
- Working as a **diverse team from industry and academia**, with different areas of expertise, in order to challenge ourselves.

Methodology

The **landscape review** helped to define what has changed and the context which SAP/RdSAP 11 needs to respond to. We have also engaged with BEIS to understand the key policy objectives SAP/RdSAP needs to support (section 1).

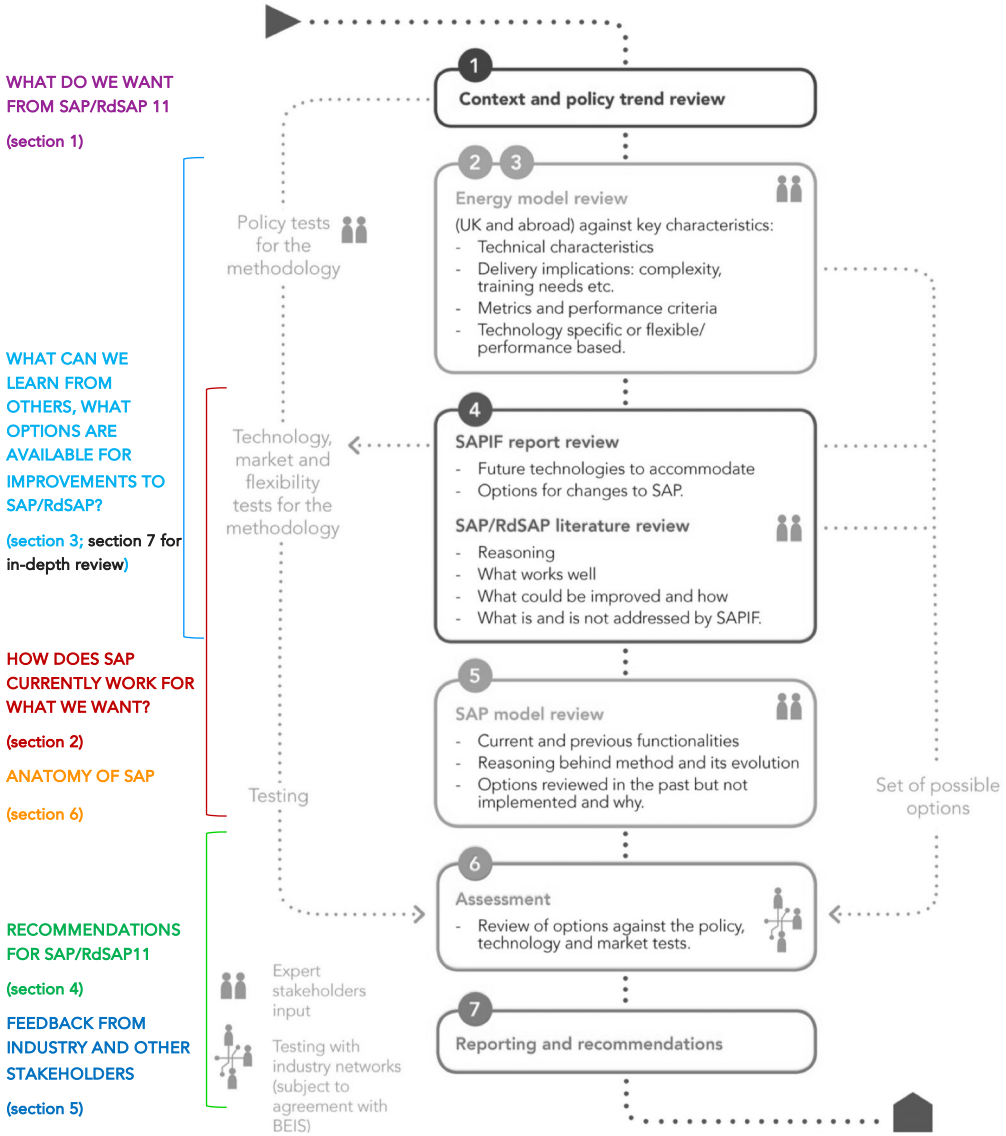
We have undertaken a **deep analysis of SAP/RdSAP** and what works well or not, to identify big and detailed issues that need addressing (section 2 and Issues Log, which should be read in conjunction with this report). This analysis also included the production of diagrams on **how SAP and RdSAP work** (i.e. inputs, calculations, outputs) (section 6).

The review of literature, advice from experts, and other modelling methodologies across the world helped us to identify **possible solutions** (sections 3 and 7).

This led to **25 key recommendations** which together form a solution, based on our analysis of what SAP/RdSAP needs to achieve and what the options are (section 4).

Engagement with industry helped to gather information and test and refine our recommendations (section 5).

We have done our best to be specific about the use of "SAP" and "RdSAP" but for the avoidance of doubt, recommendations on SAP as a calculation method also apply to RdSAP, since their inputs differ but the calculation method is the same.



Methodology adopted for this process, and corresponding sections of this report. This review uses the draft SAP10 (version 10.1, 1st October 2019) as reference.

The need for a new SAP/RdSAP for Net Zero

The importance of SAP/RdSAP is colossal

SAP/RdSAP is not just a calculation methodology: it is integral to the delivery of policies associated with the energy performance of new homes and the whole UK housing stock, and it is used from small works to large new developments, often as design tool (even if it was not intended as such). While regulations set the requirements, it is in large part SAP/RdSAP which defines the target and the assessment of the measures proposed.

SAP/RdSAP is also a central tool for those developing, implementing and tracking policies (e.g. BEIS, MHCLG, Ofgem, Climate Change Committee, Local Authorities, National Grid), for residents (the ultimate stakeholder), and for the whole building industry (developers, affordable housing providers, housebuilders, investors, manufacturers, energy assessors, engineers, architects etc.).

Its importance cannot be overstated.

The purpose and functions of SAP/RdSAP need to be clear

SAP/RdSAP has been developed over more than 20 years and its purposes and functions have expanded over time, leading to a lack of clarity. We recommend a clarification of its purpose and a clear hierarchy of functions, as outlined opposite. SAP/RdSAP should continue to be able to perform other functions, but its main purpose should be to deliver on these priority ones.

These priority functions are derived from the key objectives which SAP/RdSAP is crucial for: **Net Zero Carbon**, **energy efficiency** (including demand reduction and flexibility), and **heat decarbonisation**. Reducing fuel poverty is also a key objective which SAP/RdSAP needs to help with, but SAP/RdSAP can only address some of the causes of fuel poverty, and other important levers are also available for this.

SAP/RdSAP 11 needs to be suitable for the future

SAP/RdSAP 11 is expected to be available from 2023-2024. It is therefore crucial that its development takes into account the current trends affecting housing, the energy system, technologies and innovations in performance testing.

It is also particularly important to embrace a culture based on evidence and in-use data: a new system must be put in place to track policy effectiveness and progress towards Net Zero, and continuously improve SAP/RdSAP.

1

MAIN FUNCTIONS FOR SAP/RdSAP 11

1. Encourage the right decisions for the design and construction of Net Zero Carbon ready buildings, and for the retrofit of existing dwellings towards Net Zero
2. Evaluate energy use
3. Evaluate carbon emissions, based on an average for the next 20-30 years.
4. Improve on current functions for Building Regulations purposes and the production of EPCs to better align with the other priorities.

2

SECONDARY FUNCTIONS FOR SAP/RdSAP 11

5. Evaluate energy running costs
6. Evaluate annual space heating demand
7. Provide an indication of how 'smart ready' the home is.

3

POTENTIAL ANCILLARY FUNCTIONS FOR SAP/RdSAP 11

8. Evaluate overheating risk, at a high-level at least
9. Support the holistic evaluation of building performance e.g. ventilation.

Recommended hierarchy of functions for SAP/RdSAP 11

Although SAP/RdSAP should continue to be able to perform many functions, being clear on their hierarchy would help SAP/RdSAP 11 perform its priority functions particularly well.

Key issues with the current versions of SAP/RdSAP

There is a combination of issues that affect the perception of SAP/RdSAP, how it is utilised and the usefulness of its outputs. Most relate to SAP/RdSAP itself but others to the way it works with the Building Regulations and Approved Documents (or equivalents in the devolved administrations e.g. Technical Handbook).

Key issues for Net Zero Carbon

- The EPC rating generated by SAP/RdSAP, i.e. the main metric used in policy to drive improvements to the housing stock, is an **energy cost metric, not an energy efficiency or carbon metric**. At current energy prices, this means the use of **fossil fuels** can be encouraged by EPC ratings produced by SAP/RdSAP.
- SAP-calculated carbon emissions for Part L compliance use **short-term carbon factors** which are rapidly out of date and do not reflect the lifetime carbon impact of decisions.
- The key SAP output for Part L compliance is a **relative** improvement over a **notional building**, not an absolute performance metric. This prevents evaluation of impact, tracking of progress, and benchmarking, and does not reward some important aspects of energy efficient design (e.g. building form).

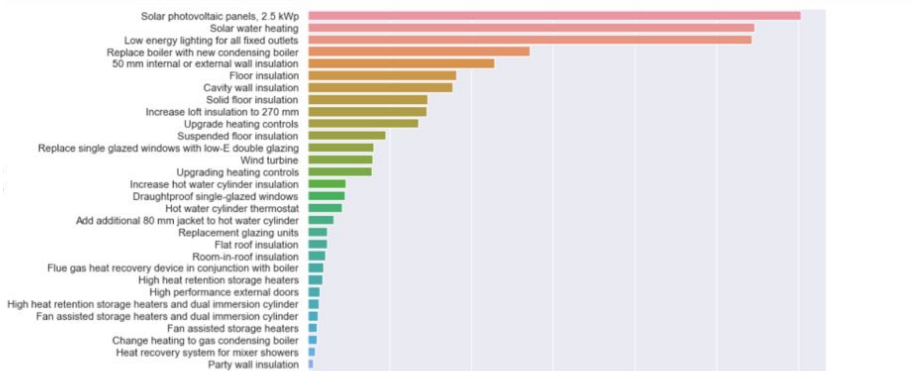
Key issues for energy efficiency and demand reduction/flexibility

- Energy use (in kWh) is **not a key SAP/RdSAP output** for Part L and EPC ratings. Primary energy, cost and carbon metrics are all system-dependent rather than reflecting the building itself and cannot directly be checked post-completion.
- The evaluation of energy use is **not accurate** (e.g. location is standardised)
- **Peak demand reduction and flexibility** are not encouraged.
- On **existing homes**, SAP/RdSAP does not set out an end-goal compliant with Net Zero Carbon nor a coherent set of options to achieve it. SAP is also not often used: Part L compliance can be achieved through elemental checks only, and EPCs are in majority produced with RdSAP, using less specific inputs.

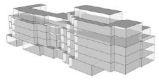
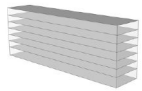
Key issues for energy efficiency and demand reduction/flexibility

The **decarbonisation of heat is currently hindered** by SAP/RdSAP.

This report focuses on the 'big issues' but we have also created a 'SAP/RdSAP issues log' to capture all issues – see Section 6 and separate Excel file for details.



Analysis of recommendations generated by SAP/RdSAP on all UK EPC certificates. While this scoping project focuses on SAP/RdSAP, and therefore EPC ratings rather than their recommendations, this is linked and clearly illustrates that the current system is not fit for purpose to put the existing housing stock on the right track towards Net Zero. For example, the installation of a heat pump is never recommended, which is partially due to the current nature of the EPC rating: a cost indicator rather than an energy efficiency or carbon metric (Source: UCL)

		Improvement over Part L (%) SAP	Space heating demand (kWh/m²/yr) SAP	Space heating demand (kWh/m²/yr) PHPP
High form factor		**35%**	18	26
Medium form factor		**35%**	15	20
Low form factor		**37%**	11	13

A more efficient form is important for low energy buildings, but it is not rewarded by the notional building approach: with similar specifications (e.g. U-values) the performance against Part L (%) calculated by SAP for the three buildings above is broadly similar despite the space heating demand being much smaller with a more efficient design (40% smaller as estimated by SAP, and 50% as estimated by PHPP).

Learning from others and working together for a better SAP/RdSAP

Building on the significant knowledge acquired over 20 years+

We have engaged with a number of experts: people who have been directly or indirectly involved in the development of BREDEM, SAP and RdSAP, people who are at the heart of the software solutions using these methodologies, and people who have had to consider SAP/RdsAP in a lot of detail through research and analysis of its accuracy, at the building or stock level. We are very grateful to all of them and their names can be found on page 5 of this report. They have explained to us why and how BREDEM, SAP and RdSAP have evolved over time and why some choices have been made. We recommend building on this great legacy.

Literature review (including the SAPIF report)

Findings from the literature review have informed all aspects of this report. We have reviewed in detail the Climate Change Committee's Future of Housing report, the SAP Industry Forum (SAPIF) Technologies report and several other relevant publications. They must inform the development of SAP and RdSAP 11.

Learning from other domestic energy modelling methodologies

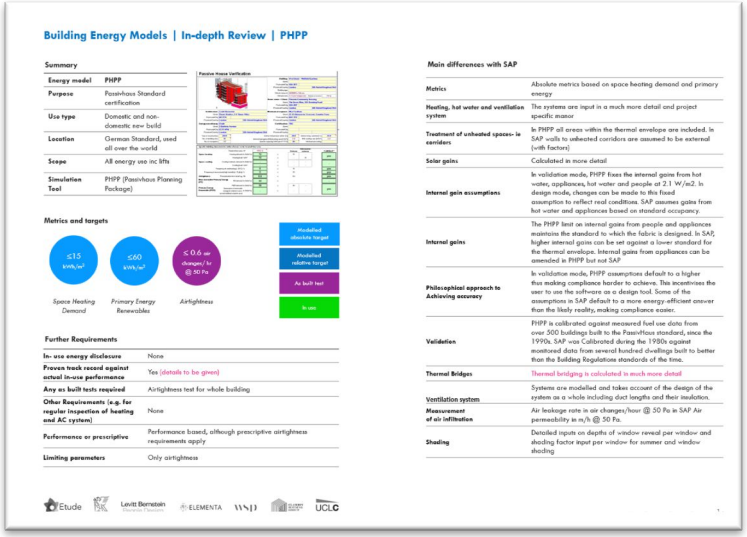
A comprehensive review of domestic energy modelling methodologies and standards used across the world has been undertaken, supplemented by a more detailed analysis of some key methodologies and by interviews with individuals whose names can also be found on page 5. PHPP is clearly a methodology to learn from but there are also others. For retrofits, methods developed in the UK as adaptations to SAP/RdSAP are considered a very good place to start.

Being ready to make new choices

It is important to acknowledge that the development of SAP/RdSAP over the last 10 years has been made somehow on an 'ad hoc' basis rather than led by a strategic vision. **As Government and the wider industry consider SAP/RdSAP a key tool to help deliver Net Zero Carbon ready buildings and the whole house retrofit of existing homes, new choices, possibly different from the ones made so far, should now be made**. In particular, the need to evaluate energy use more accurately, the energy system revolution and its impact on demand flexibility, the heat decarbonisation priority and the need for SAP/RdSAP to play a role in reducing the performance gap are key reasons for these new choices.

A selection of reports and papers included in the literature review

A review of domestic energy modelling and standards used across the world has been undertaken



A selection of methodologies has been reviewed in detail (e.g. PHPP)

25 key recommendations to make SAP/RdSAP 11 fit for Net Zero

Making SAP/RdSAP fit for Net Zero is possible

The review of policy objectives with BEIS and of the changing landscape around new and existing housing has led to the clarification of the objectives and functions of SAP and RdSAP. These functions need to derive from the key Government policy objectives which SAP/RdSAP is crucial for: **Net Zero Carbon**, **energy efficiency** (including demand reduction and flexibility), and **heat decarbonisation**.

The literature review, our engagement with experts and our review of other energy modelling methodologies around the world have all provided interesting clues as to how these objectives and functions could be better supported in SAP and RdSAP 11. They have led to **25 key recommendations**.

These recommendations focus primarily on what is within SAP and RdSAP's remit. If they are all addressed, these methodologies will be much more able to deliver their new key objectives: accompany the design and construction of new Net Zero Carbon ready new homes and the low carbon retrofit of existing homes.

Additional points to address have been identified in the Issues Log.

Addressing SAP/RdSAP as well as its ecosystem

Some of these recommendations go beyond the strict boundaries of SAP/RdSAP. They have been made to ensure that there is consistency between methodologies and their 'eco-system', which is absolutely crucial as the right environment will make changes to the methodology even more effective, and a number of important issues cannot be resolved by SAP/RdSAP alone. The development of the Future Homes Standard provides a natural opportunity for both SAP and its regulatory environment to be considered together. for these improvements to be considered.

	Alignment between SAP/RdSAP and its strategic objectives
1	SAP can and must become a tool for Net Zero Carbon ready new buildings
2	SAP/RdSAP can and must become a better tool for whole house retrofit
3	SAP/RdSAP can and must become better at evaluating energy use
4	Homes need to become smart ready and SAP/RdSAP needs to help with this
5	SAP can and must play a bigger role in reducing the performance gap

	Improvements to the methodology
6	Carbon factors: replace the short term with long term factors (e.g. 25-year average)
7	SAP should remain a steady-state monthly tool, but with a new module for flexibility
8	SAP should 'tell the truth' and enable bespoke non-regulatory uses
9	A significant improvement of Appendix Q and the PCDB process is required
10	Overheating: towards a simplified 'flagging system'?
11	SAP/RdSAP outputs need to be compatible with disclosure and data analysis goals
	Improvements to SAP/RdSAP and its ecosystem for Net Zero
12	No more notional building: the introduction of absolute energy use targets
13	New metrics for Net Zero Carbon (and not primary energy)
14	Better governance: a modular architecture and an evidence-based culture
15	New EPC ratings from SAP/RdSAP to support Net Zero and fuel poverty objectives
16	SAP should be fully integrated in the digital age
	A better evaluation of energy use
17	Location should be taken into account and not normalised as it is now
18	Domestic hot water should be modelled more accurately
19	SAP/RdSAP should better model the energy performance of ventilation systems
20	Thermal bridges: good practice should be rewarded (and bad practice penalised)
21	SAP needs to better reflect all energy uses, including cooking and white goods
22	Occupancy: the standardised assumptions should be re-validated
	Support to decarbonisation of heat and electricity
23	SAP/RdSAP needs to model all heat pump systems accurately to reward efficiency
24	Heat networks: SAP/RdSAP should evaluate distribution losses more accurately
25	Solar Photovoltaics require better modelling and a prominent SAP/RdSAP output

The result: a better SAP/RdSAP towards Net Zero

Priority policy objectives		SAP/RdSAP 11 potential performance against objectives
Net Zero Carbon by 2050	✓	**Significant improvements** • The redefinition of SAP's main purpose as a tool to assist the delivery of Net Zero Carbon ready new buildings would ensure **alignment between the strategic objective, the process of designing and constructing new homes and the SAP methodology**. • SAP and RdSAP would better **support a whole house retrofit approach** and indicate what improvements to energy and carbon performance are possible, which means opportunities could be identified, accelerating improvements to and decarbonisation of the existing stock. • **The SAP outputs would be used against an absolute target**, consistent with the nature of the Net Zero Carbon target which is absolute. • SAP would consider regulated and unregulated energy uses, i.e. total **energy use**. • This total energy use metric can be checked post-completion and therefore it would create **a positive feedback loop**, increasing clarity for consumers and enabling government to monitor policy effectiveness, track decarbonisation and carry out forecasting to achieve Net Zero. • SAP would use medium-term carbon factors (e.g. 25-year averages) which would reflect forward-looking scenarios for the electricity grid, better representing the average carbon emission of a home over the next 25 years, rather than its immediate emissions.
Improving energy efficiency and reducing demand New and existing homes	✓	**Significant improvements** • The key metric in SAP/RdSAP would be **energy use**, the best indicator of energy efficiency. • The evaluation of energy use would be **more accurate by having an assessment based on the actual location of the dwelling** (e.g. regional). • Additional **accuracy** would be possible by enabling users **to adjust inputs for non-regulatory purposes** e.g. occupancy, heating set points. • SAP would continue to include a fabric and ventilation efficiency metric to express thermal demand related to **fabric performance**. This metric may be a Space Heating demand metric or the Heat Transfer Coefficient metric. • The inclusion of an **output related to peak demand and/or demand management** (e.g. Smart Readiness Indicator, energy storage capability, peak demand) would allow SAP to value strategies aimed at reducing peak demand and at shifting demand for system flexibility. These would in turn support policies for the electricity grid to become lower carbon at a smaller cost. • Having energy use as a key metric, and better evaluating it, would also improve SAP/RdSAP's ability to support **fuel poverty** policies where it best can: reducing energy use through building performance.
Heat decarbonisation	✓	**Significant improvements** • SAP would use medium-term carbon factors (e.g. 25-year averages). This would support policies to **move away from fossil fuels**. • Key technologies for the decarbonisation of heat (e.g. **heat pumps**) would be better modelled. • The assessment of **hot water demand** would be more detailed, reflecting its growing relative proportion of total heat demand in new buildings. • SAP would no longer use a notional building, helping to accelerate the transition away from fossil fuel heating. • SAP would not include "fudge factors" intended to support particular systems or technologies; it would assess low-carbon heat options on a fair basis and support a faster transition away from fossil fuel heating.

Summary of feedback from SAP/RdSAP users: shared views

We undertook an online survey and received 337 responses. A number of questions were met with consensus and in general a undeniable support for change. Results are summarised in Section 5.0 with full results provided in Appendix H. This page highlights the key areas of consensus.

Target setting

> *An absolute figure ensures the focus remains on a directly measurable aspect, enabling simple reporting of future improvements.*

68% believe the notional dwelling is not a useful measure and that an absolute target should be set instead

Key metrics

85%

think energy use should be a key metric

kWh/m²/yr

Use SAP as a design tool

85%

would like to see the SAP methodology also used for non-regulatory purposes, with more detailed inputs, allowing for a more accurate assessment of building performance

> *Is there any justification for not doing this?*

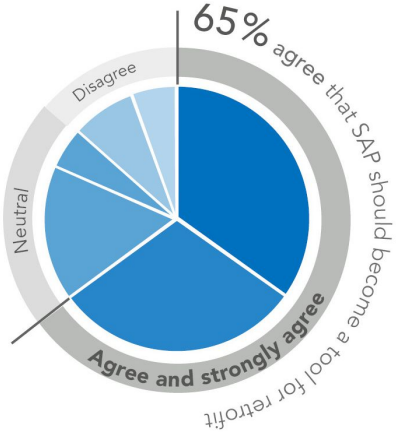
> *This would help to communicate the difference between SAP as a regulatory tool and as a potential model for individual dwelling performance.*

Use SAP for retrofit

It is clear that respondents think SAP should be a tool to better inform retrofit.

80-87% thought that to be a sufficient retrofit tool SAP should:

- Evaluate possible deep retrofit 'end goals'
- Introduce prompts to encourage 'whole-house thinking'
- Take better account of airtightness and other associated improvements



Those who did not, tended to think that SAP was not a detailed enough calculation methodology at the moment.

Encourage demand management

80%

agree, with over half of these strongly agreeing.

75-80% agreed that to do this SAP should account for:

- Peak electrical demand
- Thermal storage
- Smart technologies
- Electrical storage

Use actual dwelling location

90%

agree that SAP should be based on a dwelling's actual location, rather than a normalised one

The anatomy of SAP and RdSAP: diagrams

Visualising the different components of SAP and RdSAP

It may appear to be a detail, but we think that the absence of a diagram expressing how SAP and RdSAP work represents a barrier for a better understanding of what could/should be improved.

For this reason, we have produced a number of diagrams as part of this scoping project:

1. a SAP 2012 diagram
2. a SAP 10 diagram
3. a simplified SAP 10 diagram
4. an RdSAP diagram.

Using these diagrams to understand differences and assist development

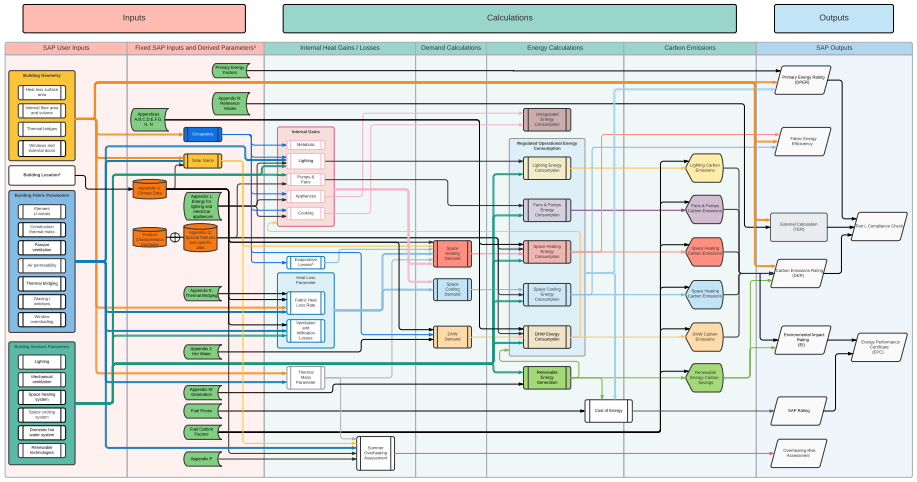
We have used these diagrams to visualise differences, i.e.

- changes between SAP 2012 and SAP 10
- differences between SAP and RdSAP.

There is additional potential in the future to use these diagrams to visualise where changes are required and where underlying evidence is weaker.

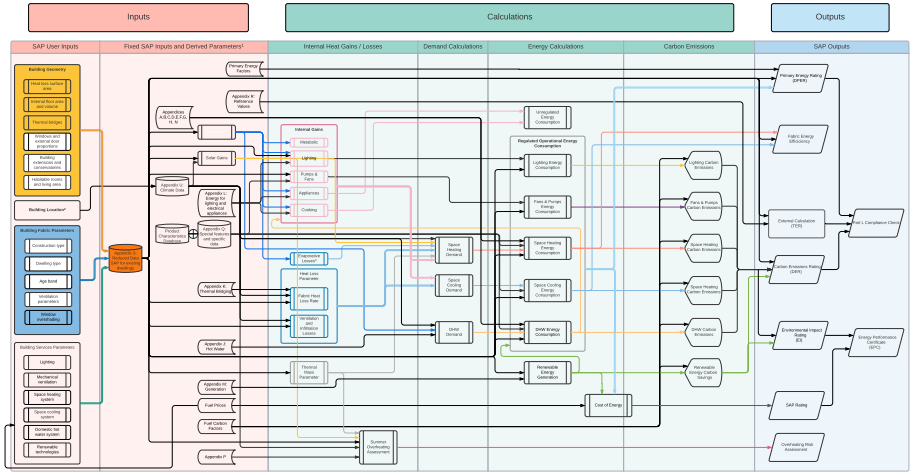
Developing a more open development culture around SAP

We recommend that similar diagrams are developed for SAP and RdSAP 11. They could contribute towards a more open development culture around SAP with the update of different component parts or modules being displayed more clearly or call for evidence for other elements.



SAP 10 diagram *developed as part of this SAP 11 scoping project*

(larger size available in Section 6)



RdSAP diagram *developed as part of this RdSAP 11 scoping project*

(larger size available in Section 6)

Next steps

The aim of this project was to summarise which issues should be addressed by SAP/RdSAP 11 and to provide a set of clear recommendations for the team who will develop them.

In the process of developing these recommendations, we have been able to identify areas where there is a strong consensus and others where opinions are more split. Based on our engagement with experts and on the online survey, recommendations in the adjacent table which are marked with three ticks ✅✅✅ have a particularly high level of support in the industry.

We have also provided an assessment of the level of complexity associated with delivering each recommendation. The adjacent table seeks to summarise this: recommendations marked with three "plus" (**+++)** are more complex, so they will require time to develop and incorporate satisfactorily in SAP/RdSAP 11. These include:

- The role of SAP and RdSAP to help deliver the whole house retrofit of existing homes
- How SAP can help homes to become smart ready (i.e. how it can assess peak demand reduction and shifting to coincide with renewable energy generation) and the development of the associated new SAP module providing more functionality and flexibility
- A review of the role and the process of Appendix Q and the PCDB.

		Level of consensus	Level of complexity
1	SAP can and must become a tool for Net Zero Carbon ready new buildings	✅✅✅	+
2	SAP/RdSAP can and must become a better tool for whole house retrofit	✅✅	+++
3	SAP/RdSAP can and must become better at evaluating energy use	✅✅✅	++
4	Homes need to become smart ready and SAP/RdSAP needs to help with this	✅✅	+++
5	SAP can and must play a bigger role in reducing the performance gap	✅✅	++
6	Carbon factors: replace the short term with long term factors (e.g. 25-year average)	✅✅	+
7	SAP should remain a steady-state monthly tool, but with a new module for flexibility	✅	+++
8	SAP should 'tell the truth' and enable bespoke non-regulatory uses	✅✅✅	+
9	A significant improvement of Appendix Q and the PCDB process is required	✅✅	+++
10	Overheating: towards a simplified 'flagging system'?	✅	++
11	SAP/RdSAP outputs need to be compatible with disclosure and data analysis goals	✅✅	+
12	No more notional building: the introduction of absolute energy use targets	✅✅✅	+ new / ++ existing
13	New metrics for Net Zero Carbon (and not primary energy)	✅✅✅	+
14	Better governance: a modular architecture and an evidence-based culture	✅✅	++
15	New EPC ratings from SAP/RdSAP to support Net Zero and fuel poverty objectives	✅✅✅	++
16	SAP should be fully integrated in the digital age	✅✅✅	++
17	Location should be taken into account and not normalised as it is now	✅✅✅	+
18	Domestic hot water should be modelled more accurately	✅	++
19	SAP/RdSAP should better model the energy performance of ventilation systems	✅✅	+
20	Thermal bridges: good practice should be rewarded (and bad practice penalised)	✅✅	++
21	SAP needs to better reflect all energy uses, including cooking and white goods	✅✅	++
22	Occupancy: the standardised assumptions should be re-validated	✅	+
23	SAP/RdSAP needs to model all heat pump systems accurately to reward efficiency	✅✅	++
24	Heat networks: SAP/RdSAP should evaluate distribution losses more accurately	✅✅	++
25	Solar Photovoltaics require better modelling and a prominent SAP/RdSAP output	✅✅	+

Next steps | Learning from domestic energy modelling methodologies across the world

Domestic energy models for new and existing dwellings from Europe and across the world have been reviewed, along with their ecosystems (e.g. the regulatory framework around them). This page provides a summary of our findings and how they can help to inform the development of some key aspects of SAP/RdSAP.

40+ ecosystems, modelling methods and tools reviewed

10 European countries

8 Countries/ states outside of Europe

8 Voluntary standards and methods for existing buildings

9 Voluntary standards that focus mainly on new buildings

10 Regulatory standards

15 Simulation tools

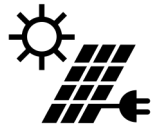
Best practice ecosystems

- A clear long term target definition of zero carbon
- Stepped targets, and clarity on future targets that improve over time
- Various routes to compliance
- Building labelling and disclosure
- Best-in-class building fabric
- Scrutiny of thermal bridging and details
- Clear differentiation between design checks and in-use reporting
- Enhanced energy modeller qualifications
- Inclusion of embodied carbon, refrigerant leakage and resilience metrics

Of the reviewed regulatory and voluntary standards:

12 have a total energy use (EUI) metric

15 have a space heating metric



13 have an on-site renewables metric

18 have an absolute target

12 Methods encourage fabric first standards and are steady state

11 require data disclosure

Best practice modelling methodologies

- Same tool used for regulation and voluntary standards
- Methods used for both regulatory compliance and predictive modelling, but often allowing different inputs and functionality
- Evolution of metrics and targets over time
- Reporting and reducing peak energy use
- Holistic design taking account of energy and overheating
- Clear reporting templates
- Different methodologies depending on the scale of the development

Best practice tools

- Simple user interface
- Transparency of simulation tool

Acknowledgments

Department for Business, Energy & Industrial Strategy

We would like to thank everyone at BEIS who led and contributed to this study.

We are also immensely grateful to the experts and stakeholders who have generously given their time to share their experience with us and answered our questions.

Each and every interview has shed an interesting light on SAP/RdSAP's past, present and future.

Tim Baldwin (Shropshire Council)
George Bennett (UCL)
Anna Braune (DGNB)
Julian Brooks (Good Homes Alliance)
Phil Brown (NSG Group)
Niels Bruus Varming (Danish Housing Authority)
John Burke (Building Regulations Unit, NI)
Ronan Casey (Building Regulations Unit, NI)
Juan F. Coronel (University of Seville)
Neil Cutland (Cutland Consulting)
Pierre Damolis (Alto Ingénierie)
Hywel Davies (CIBSE)
Jane Devlin (East Hampshire District Council)
Jeroen Drees van der Sluijs (Plan-AE)
Stuart Fairlie (Elmhurst Energy)
Ian Ferguson (Stroma)
Tilly Ford (Enfield Council)
Paul Keepins (Planning Directorate, Welsh Government)
Haley Gardner (International Living Futures Institute)
David Glew (Leeds Beckett University)
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This report seeks to reflect the consensus rather than each individual view. The experience of the individuals below and the SAP related groups (SAPIF and SAPSIG), their past and present work must continue to fertilise the development of SAP and RdSAP 11.

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… and all 337 survey participants!

Project team

This report is the result of a collaboration between partners with different perspectives and experiences but a shared ethos of excellence and knowledge sharing.

The team spans the whole life cycle of a dwelling from planning through design, from construction to operation, with significant experience in both private and affordable housing.

The hard work of these individuals as well as their debates and discussions have been invaluable. They have led to a study which is far more than the view of one single organisation.

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This document is a short summary. The full report should be referred to for more details.

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