
PAS 2050 research report

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Background to this research

PAS 2050:2008 – *Specification for the assessment of the life cycle greenhouse gas emissions of goods and services* – was originally developed in 2008 by BSI and sponsored by Defra and the Carbon Trust in response to a call from the business community for guidance on single-impact quantification and the development of a consistent approach to its delivery. Prior to that, work elsewhere had focused on methodologies to enable greenhouse gas (GHG) emissions to be assessed at the organizational level. The World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) had jointly published the *Corporate Accounting and Reporting Standard* (revised in 2004). The International Organization for Standardization (ISO) also published an organizationally focused specification: ISO 14064, *Greenhouse gases 1— Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals*.

Since 2008 there has been growing interest in the theory and practice of quantification of GHG emissions from goods and services, facilitating greater

understanding and encouraging continuing development of quantification methodologies, both at a national and an international level.

In the 2008 edition of PAS 2050, there were sections of the methodology that the drafting experts noted as being areas where understanding was acknowledged to be limited and where the topic potentially needed early review/revision. These were identified in the published PAS 2050 as:

- Aircraft emissions (Clause 5.1.2)
- Indirect land use change (Clause 5.5)
- Carbon storage in soils (Clause 5.6)
- Capital goods (Clause 6.4.3)
- Product category rules (Clause 6.4.8.2)
- Reference to the International Reference Life Cycle Data (ILCD) system (Clause 7.4.2)
- Recycling (Clause D.2)

These will all be revisited during the review process.

Purpose of this research

A public commitment to review the published PAS 2050 was made by Defra and BSI when the specification was launched in 2008 – it is also part of the BSI PAS process, to review Publicly Available Specifications in not more than 2 years from the date of publication.

It is therefore to inform this process that BSI has undertaken a review of the use of PAS 2050 since its original publication and the introduction of other schemes for quantification of GHG emissions from goods and services, currently in operation, and for which this report has been prepared.

The aim of this report is to present the findings of the research, including review and synthesis of the information sources listed below, in order to provide those undertaking the review of PAS 2050 with the evidence of the areas the review should give special attention to:

- BSI Survey of those who had downloaded PAS 2050 – the research initially involved a web-based survey, which sought information on experiences on the use of PAS 2050 during the 2 years since its publication
- User trials – application trials and related workshops had been hosted by Defra with a view to testing the practical use of PAS 2050 methodology and supporting guidance in three different manufacturing and service organizations
- Feedback – BSI also received some feedback from practitioners during the period since the original publication, and further feedback was sought from

the Carbon Trust in relation to experiences in the application of PAS 2050

- Other methodologies – the research also sought to identify and acquire examples of other GHG quantification methodologies, relating to goods and services, currently employed around the world. This was done primarily on the basis of desk-based research during October and November 2010 but with some direct contact with specific representatives from the WRI, the WBCSD and ISO/TC 207¹⁾, as it is with the methodologies currently being developed by these organizations that PAS 2050 is primarily being compared. Copies of the most recent versions of the identified methodologies have been reviewed and conclusions drawn with regard to their potential influence on the revision of PAS 2050

The key aspects derived from the review, and the evidence that is believed to support their identification as being of importance to the future development of PAS 2050, are summarized in Findings from Research (see p. 5). This information is then considered further in the Conclusions and Recommendations section, where the recommendations are judged to constitute areas for particular attention during the review and revision of PAS 2050.

This report has been prepared by Brian Such MCMI, Project Manager at BSI.

¹⁾ ISO/TC 207 is ISO's Technical Committee 207 – Environmental Management.

Findings from research

BSI Survey (Appendix A)

A web-based survey was undertaken between 2 September and 24 September 2010 to enable feedback from those who had downloaded PAS 2050 and the supporting Guidance document. BSI sought to identify whether and how these stakeholders had implemented the specification, and to explore their experience of using it in the quantification of the GHG emissions from goods/services. A summary of these responses is provided in Appendix A. The following information, seen as being germane to the PAS 2050 review, has been extracted from that survey.

The survey was completed by 1,018 respondents from organizations of all sizes, although 57.3% claimed to have over 100 employees. Of the activity sectors identified, consulting and professional services constituted the largest responding group by a considerable margin (see Figure 1).

Although 38% of respondents identified themselves as being based in the UK, the overall picture (see Figure 2) shows that the PAS 2050 methodology has been used in many parts of the world, notably wider Europe (26%) and Asia Pacific (10%) (see Figure 3).

The three most cited reasons for using the PAS 2050 methodology (see Figure 4) are in line with the objectives identified in the development of PAS 2050. However, the mid-table position of public relations and image-raising does perhaps pose questions with regard to not including requirements for communication or quantification results in PAS 2050.

When questioned as to the benefits derived from this application, 52% of respondents identified 'a better understanding of their organization's processes', whilst 42% claimed to have achieved a reduction in GHG emissions, and 32% cited achievement of cost savings and efficiencies (see Figure 5).

In line with the findings from the question about the main drivers for using PAS 2050, 36% of respondents indicated that they believed the image of their organization to have been improved.

Of the 19% of responses in the 'other' category, an interesting development is that several respondents claim to have derived benefit in connection with 'education' university degree courses.

Of particular significance to the review of PAS 2050 is whether those downloading the document who had in fact used it (see Figure 6) had found the published specification to be clear and user-friendly and whether they experienced particular difficulties with its application.

With regard to the clarity of the specification, the survey responses indicated that, although 43% of users claimed to have found the document easy to use, a greater proportion (52%) had some issues with understanding the methodology. Just 4% reported that they had found the document to be not at all clear (see Figure 7).

For those who decided not to use PAS 2050, the top five reasons given (see Figure 8) were:

- Complexity of process (22.0%)²⁾
- Difficulty in obtaining GHG emissions data (18.8%)
- Use of other methodology (17.1%)
- Lack of demand/pressure from customers (16.4%)
- Waiting for ISO 14067³⁾ or the GHG Protocol Product Standard (15.8%)

Of the 15.4% of respondents that identified 'other' for not using PAS 2050, the strongest messages were that they were 'sourcing the PAS for reference only' or that the 'decision was yet to be made'; there was also reference to the lack of a related label or mark and the 'absence of implementation tools'. There were also one or two references to PAS 2050 being inadequate, e.g. 'fundamentally flawed in its methodology' and not reflecting state-of-the-art life cycle assessment (LCA) methodology. However, respondents did not provide specific indication as to the nature of this flaw, and no specific recommendations were provided by respondents to assist revision of PAS 2050.

The range of difficulties reported is extremely diverse, but concerns about the complexity of the methodology constituted the most significant feature, with the most

frequently expressed message being a request for more examples of use and application guidance. Specific expression of concern was raised with respect to the following topics:

- Boundary setting
- Allocation of emissions to co-products
- Land use change
- The exclusion of capital goods

Respondents identified the areas of difficulty experienced in actual application of PAS 2050 (Table 1).

With regard to what was considered to be missing from PAS 2050, 149 respondents, submitted suggestions as to where additional information might be beneficial. The topics identified are listed in Table 2.

In the published PAS 2050, certain topics were identified as possibly requiring further development. In response to a request to identify those that were still considered important, the topics shown in Figure 9 featured strongly for all respondent categories.

²⁾ The percentage figure for complexity is composed of two elements: complexity generally (11.3%) and complexity for the size of the organization (10.7%).

³⁾ ISO 14067, *Carbon footprint of products — Requirements and guidelines for quantification and communication*.

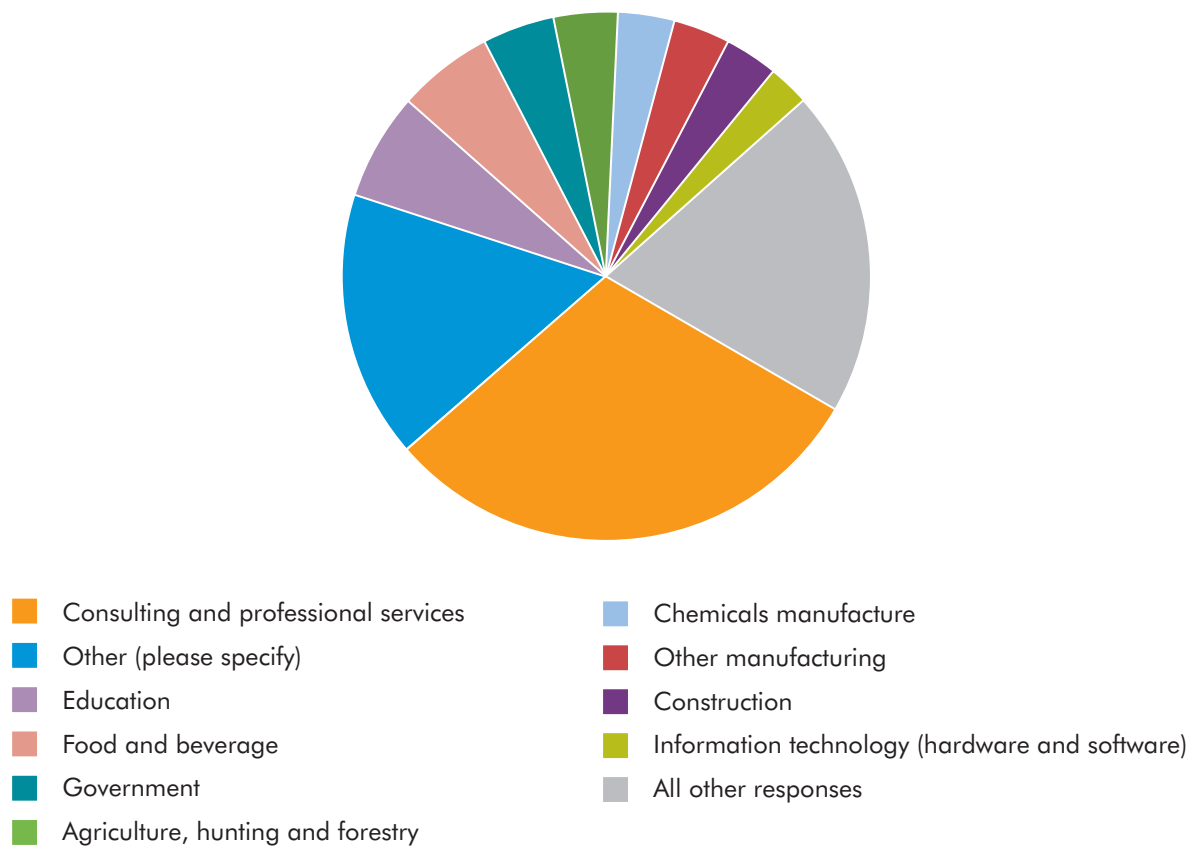


Figure 1 Response rate by organization 'primary activity'

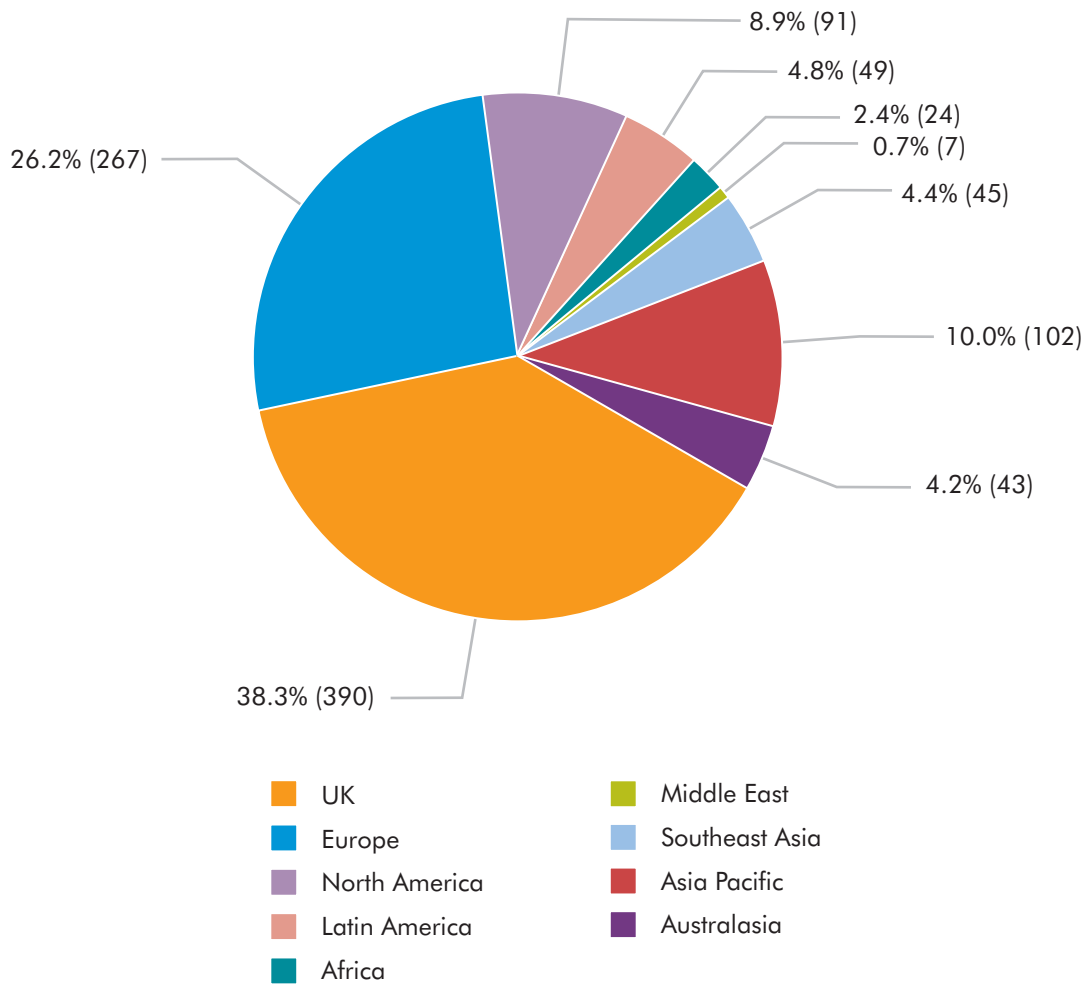


Figure 2 Where are respondents based?

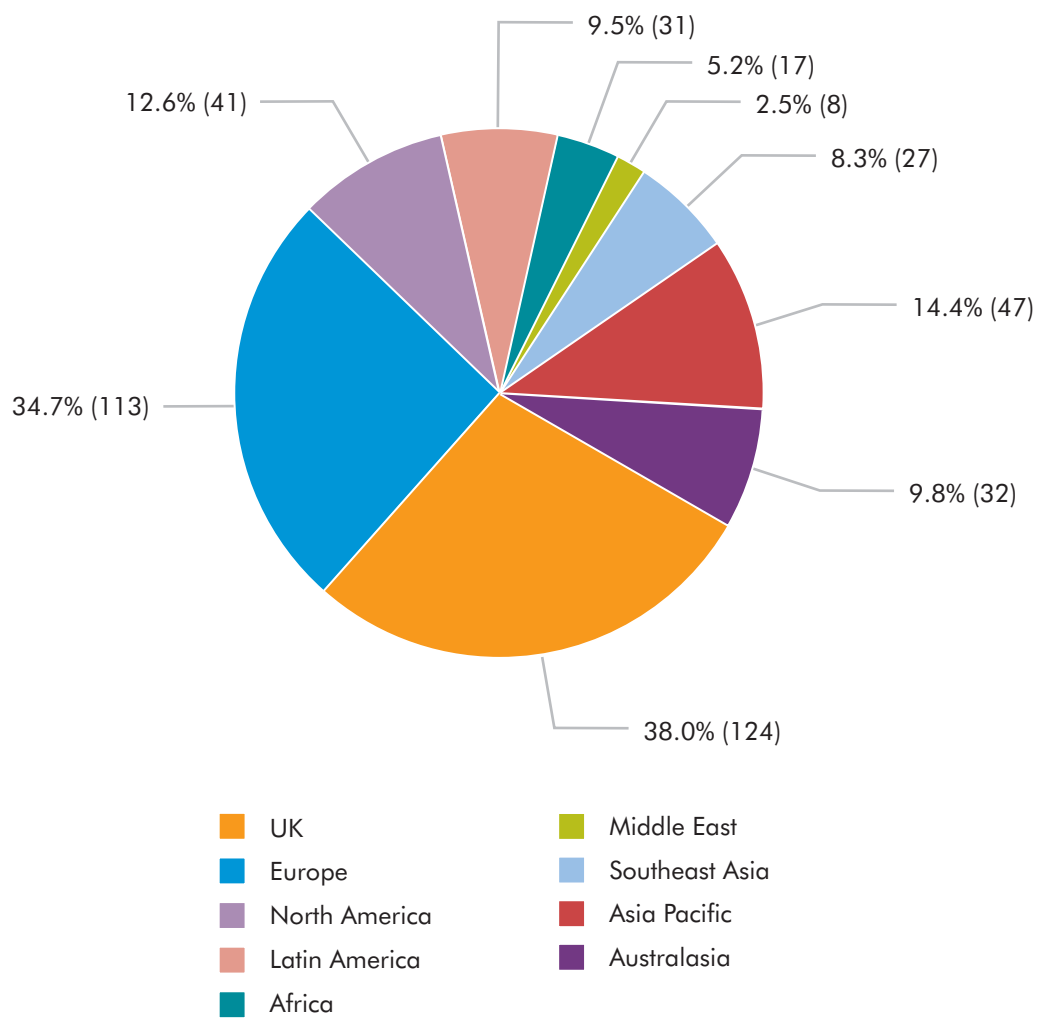


Figure 3 Where have respondents used PAS 2050?

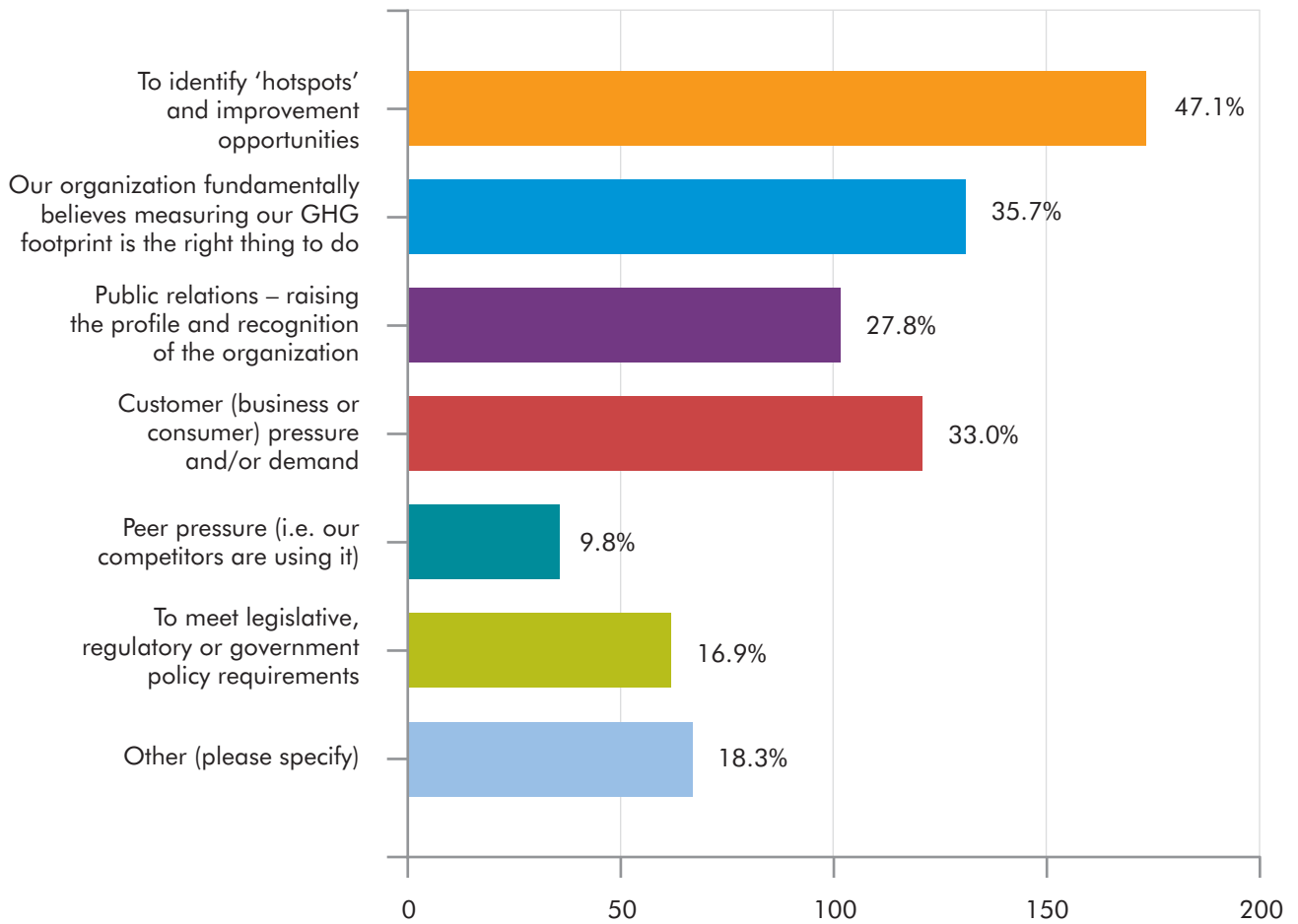


Figure 4 Main drivers for organizations to measure GHG emissions associated with their goods and services

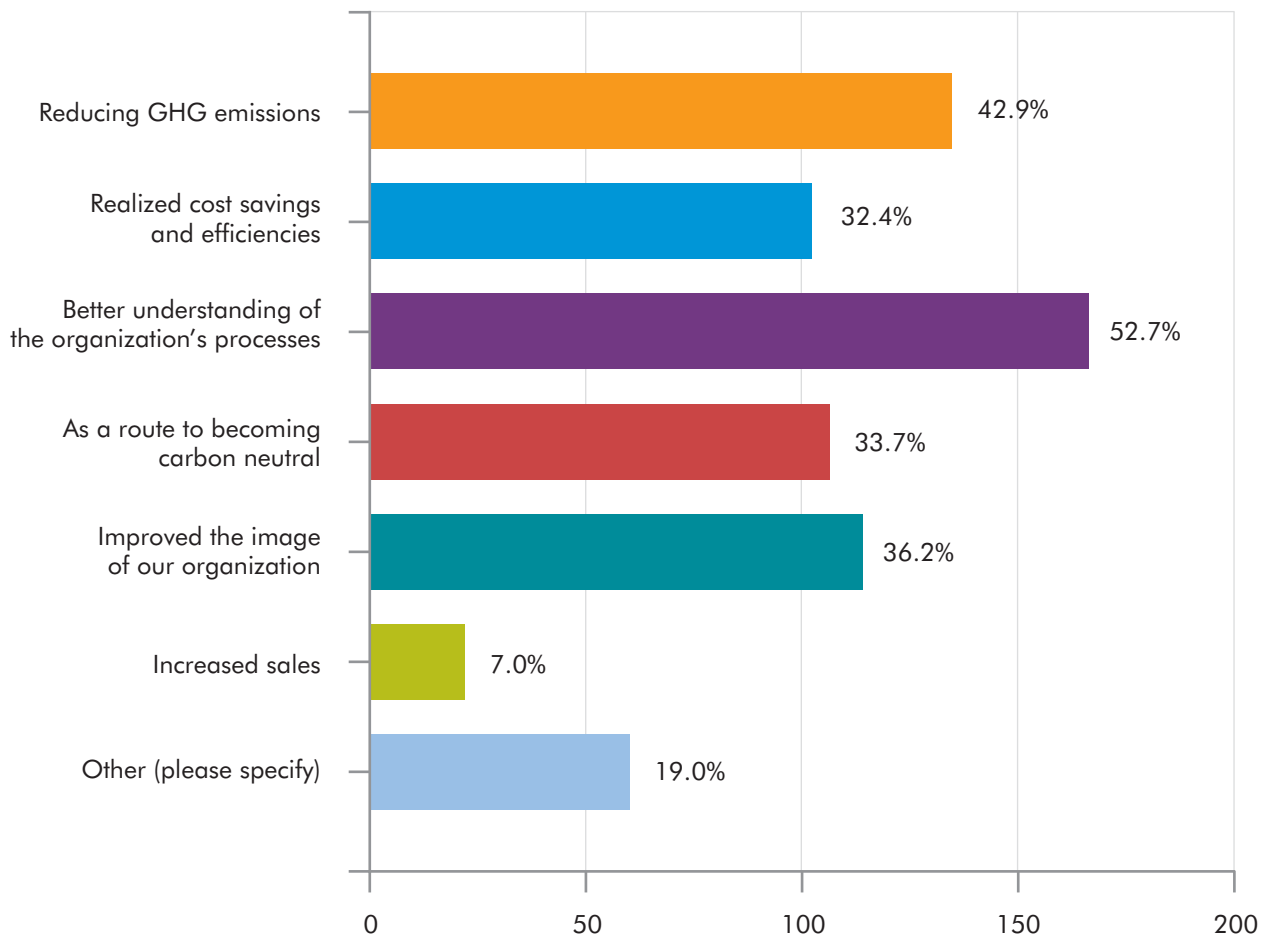


Figure 5 What benefits have been realized from using PAS 2050?

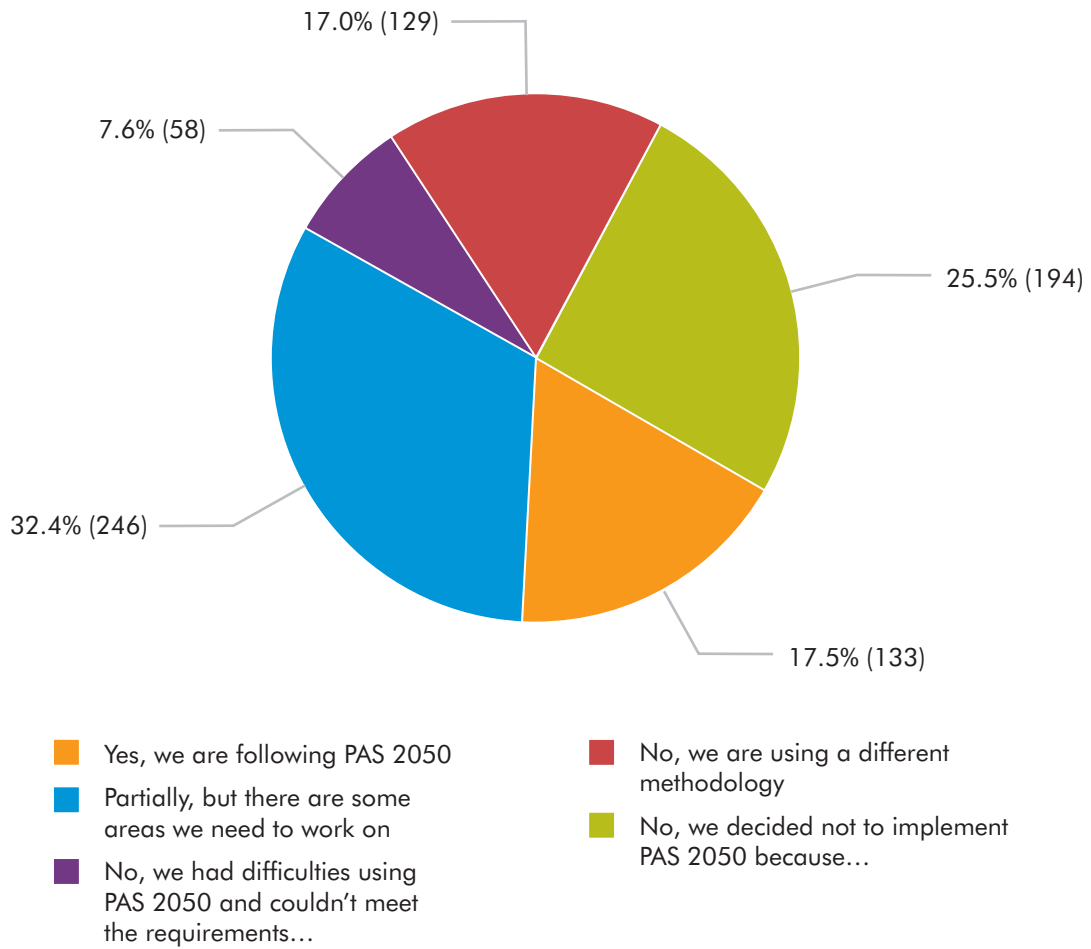


Figure 6 Have you used PAS 2050 to measure the GHG footprint of your goods and/or services?

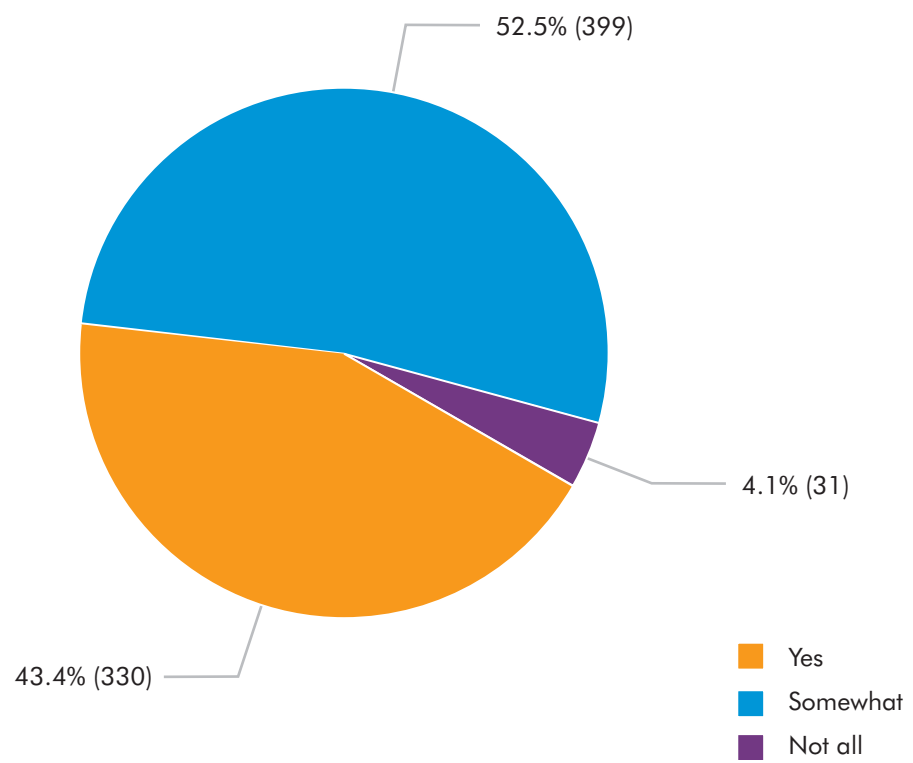


Figure 7 Is PAS 2050 clear, user-friendly and easy to understand?

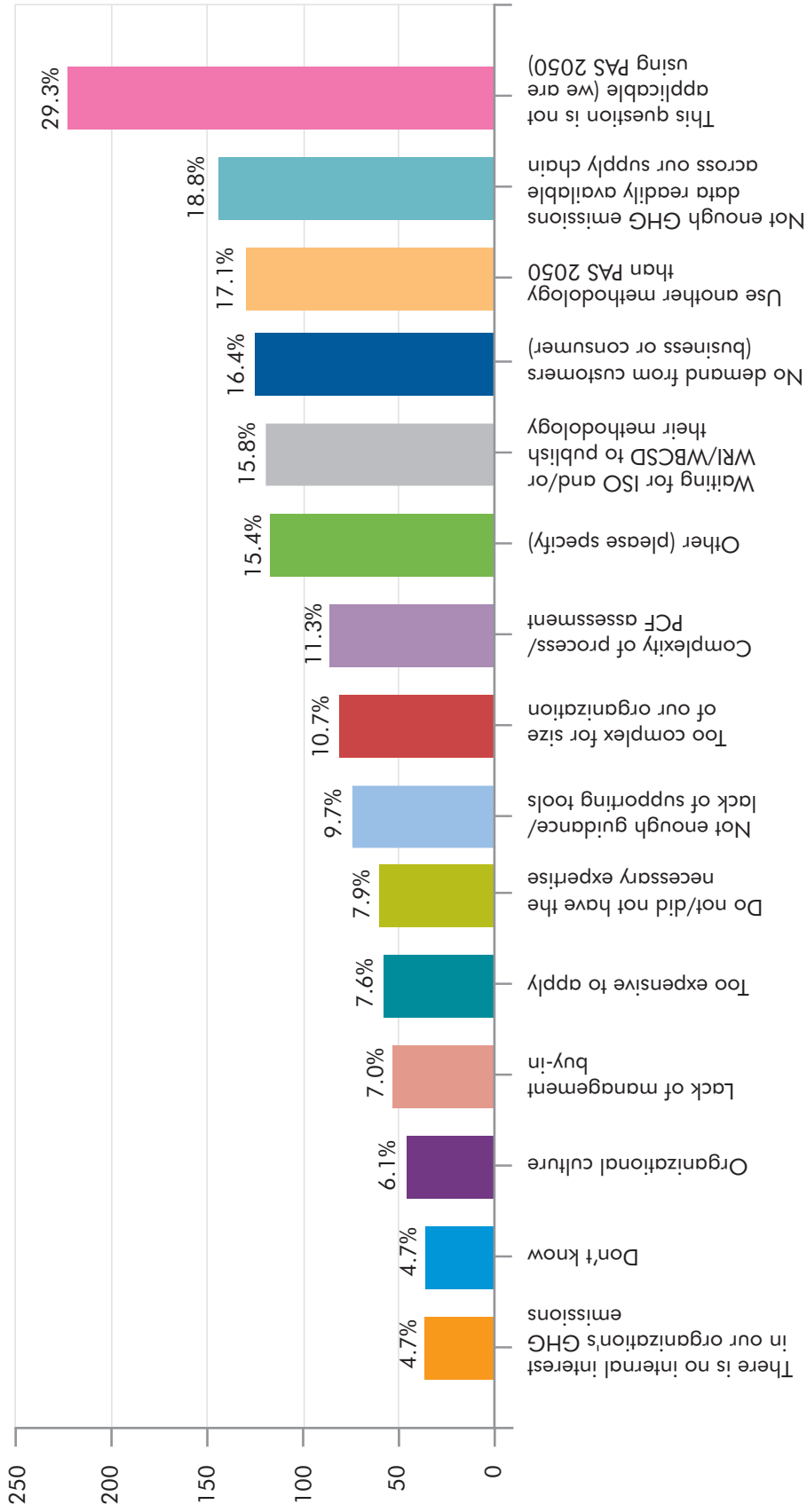


Figure 8 Factors contributing to decisions not to use PAS 2050

Table 1: Areas of difficulty experienced in the application of PAS 2050

Areas of difficulty identified	Percentage of responses	Sector
Sourcing reliable data	21.7%	Spread across most respondent categories
Allocation of emissions to co-products	6.7%	Chemical manufacturers Consultants and professional services Food and beverage
Recycling	5%	Consultants and professional services Food and beverage Metal products manufacture
Carbon capture/sequestration	3.3%	Agriculture Food and beverage Other

Table 2: Suggested additions to PAS 2050

Provision of additional guidance/worked examples for:	system boundary setting allocation land use change capital goods recycling
Provision of pointers to external data sources: e.g. Defra/DECC and standard emissions data	Part of the general concern with respect to the difficulties experienced in sourcing relevant data, including global warming potential; emission factors; conversion tables and calculation tools
Explanation of the relationship with ISO and WRI/WBCSD standards and Carbon Trust Footprint Expert	General concern at potential proliferation of methodologies
Use of product category rules (PCRs)	Request for greater clarity on how to apply PCRs alongside PAS 2050

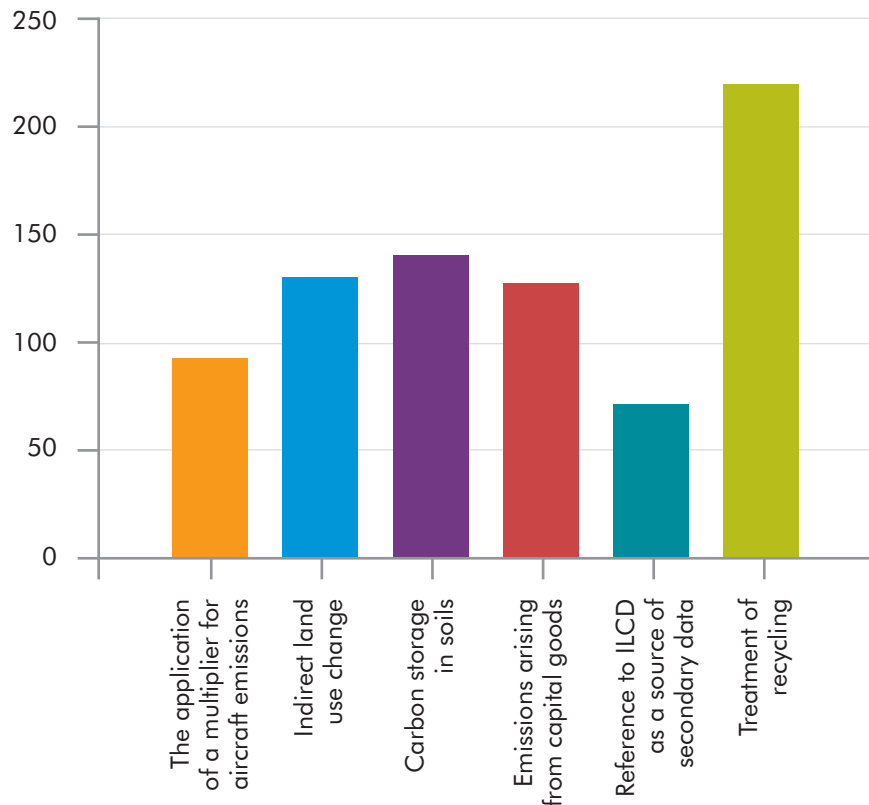


Figure 9 Topics highlighted for future attention in the revision of PAS 2050

Comment submitted by users

During the first 2 years of use, the text of PAS 2050 was made available for comment by users via a link on the BSI website. Comments submitted raised three issues, as follows.

Allocation of emissions to co-products

Comment 1

The hierarchy or stepwise procedure for allocation to co-products should be changed so that it is the same as in BS EN ISO 14044:2006, Clause 4.3.4.2,⁴⁾ i.e. the last paragraph in the current PAS 2050 Clause 8.1.1 should be deleted and replaced with Steps 2

and 3 from BS EN ISO 14044:2006, Clause 4.3.4.2. For example, various published studies with animal products have shown strong links between feed intake and production of products, and that most of the dominant GHG emissions from methane and nitrous oxide are determined by feed intake.

Proposed change

Delete the last paragraph in Clause 8.1.1 and replace with:

- c) the inputs and outputs of the system should be partitioned between the co-products in a way that reflects the underlying physical relationships between them
- d) allocation between co-products in proportion to the economic value of the co-products based on an average of 5 years data (i.e. economic allocation)

⁴⁾ BS EN ISO 14044:2006, *Environmental management — Life cycle assessment — Requirements and guidelines*.

However, there was no justification provided for this or the following change.

Comment 2

It is recommended that economic allocation is based on average prices over a period of time (e.g. a minimum of 3 years and preferably 5 years) to reduce the temporal variability in relative prices of co-products.

Proposed change

Link with the previous recommended change to delete the last paragraph in Clause 8.1.1 and replace with:

- c) the inputs and outputs of the system should be partitioned between the co-products in a way that reflects the underlying physical relationships between them
- d) allocation between co-products in proportion to the economic value of the co-products (i.e. economic allocation)

The treatment of biogenic carbon

The commenter submits recommendation in respect of:

- Harmonization and alignment of product carbon footprint (PCF) standards

- Accounting for biogenic carbon in PCF
- Reporting PCF information

as set out in Table 3.

Variation of product over time

This comment was submitted seeking clarification of Clause 7.6.

The particular issue raised concerned product supplied on a continuous basis for which there had been a change of supplier but where there was no discernible change in the appearance or function of the product.

Clause 7.6: Variability in emissions arising from the product life cycle

Where the GHG emissions associated with the life cycle of a product vary over time, data shall be collected over a period of time sufficient to establish the average GHG emissions associated with the life of the product.

Where a product is made available on a continuing basis, the assessment of GHG emissions shall cover at least one year. Where a product is differentiated by time (e.g. seasonal products), the assessment of GHG emissions shall cover the particular period associated with the production of the product.

Table 3: Recommendations for the treatment of biogenic carbon

Area of recommendation	Specific points	Reasoning
Harmonization and alignment of PCF standards	As several standards (ISO 14067, the GHG Protocol and PAS 2050) are developed in parallel, it is important that their approach and principles are consistent with one another and with generally accepted LCA guidance such as ISO 14040 ^(a) /14044 and the <i>ILCD Handbook</i> ^(b)	Discrepancies between PCF and LCA methods will cause confusion, waste resources and hinder the acceptance of PCF results
Accounting biogenic carbon	Transparent accounting of biogenic carbon in all stages of product life cycle	Common LCA guidance is to track all relevant flows. Therefore, both emissions and sinks of biogenic carbon shall be tracked in all life-cycle stages of a product. Carbon balances can be used to validate the correctness of the accounting at any stage and for the complete life cycle
	Biogenic carbon embodied in bio-based products	Complete information about the amount of biogenic and fossil carbon embodied in a product shall be passed on when PCF data is transferred among value-chain partners. Stoichiometric calculations and standardized physical measurements (see ASTM D6866 ^(c)) can be used to quantify biogenic carbon in a product
	Representation of end-of-life options	Where a full PCF (cradle-to-cradle) is carried out, it shall provide an accurate representation of the end-of-life fate of biogenic carbon embodied in a product, and correctly account for the storage, release or transformation of this biogenic carbon
	Defining time horizons for carbon storage	The long-term stability of a material shall be assessed with state-of-the-art scientific methods. If there is sufficient evidence to support the hypothesis that a material will remain stable for more than 100 years in a given product use or end-of-life scenario, the carbon embodied in the product shall be considered as sequestered permanently

Area of recommendation	Specific points	Reasoning
Reporting of PCF information	<p>Transparent and accurate accounting as the basis of meaningful reporting</p> <p>Customized level of reporting detail for different audiences</p>	<p>A single number for the total carbon footprint of a product will be most useful and expected by the majority of audiences. In addition, a breakdown of total GHG emissions by life-cycle stage may provide further information to support some decision-making processes. Displaying GHG emissions by type may be of interest to PCF experts, but could be confusing to general audiences</p>

^{a)} BS EN ISO 14040:2006, *Environmental management — Life cycle assessment — Principles and framework*.

^{b)} *ILCD Handbook — General guide for life cycle assessment — Detailed guidance*. See <http://lct.jrc.ec.europa.eu/assessment/publications>.

^{c)} ASTM D6866-11, *Standard test methods for determining the biobased content of solid, liquid, and gaseous samples using radiocarbon analysis*.

Recommendation for change to PAS 2050 – the Carbon Trust

The Carbon Trust submitted a paper presenting recommendations for the revision of PAS 2050. This paper contains suggestions/recommendations, as listed in Table 4.

In relation to potential harmonization with the GHG Protocol Product Standard and ISO 14067, the Carbon Trust paper agrees that this will be important from an industry take-up perspective, and suggests that an obvious starting point would be terms and definitions.

Table 4: Recommendations for the treatment of biogenic carbon

Clause	Topic	Comment/suggested change
2	Normative references	Ensure all cross-references are to the most appropriate standards, e.g. ISO 14040/14044
5.4	Carbon storage and delayed emissions	Retain these sections as they reflect the science of GHG emissions and climate change. However, the formula for the treatment of delays arising from the storage of biogenic carbon within the product system should be reviewed to ensure the impact is correctly captured
5.5	Land use change	Consider: <ol style="list-style-type: none"> 1. Freeing up the worst-case accounting where the origin is unknown. While such accounting makes sense, it may be too onerous (e.g. knowing the crop and country limits the possible maximum assumed emissions) 2. Linking the above to the level of verification (e.g. allow for greater refinement of the assumed land use change (LUC) emissions factor where independent accredited third-party verification is achieved; do not allow it for other party or self-certification) 3. Removing the baseline (1990) and just saying 'in the last 20 years'. This would be less penalizing of developing countries, and be consistent with the WRI protocol 4. Indirect LUC ...? <ul style="list-style-type: none"> – Treatment of agro-forestry: clarification of LUC emissions from selective logging and agro-forestry would be beneficial – Conversion of (degraded) land to a higher-carbon storage form, perhaps addressed in a note, due to (a) lack of permanence, and (b) absence of a product system in many cases
5.6	Soil carbon change	Retain exclusion of carbon uptake by soils, but: <ul style="list-style-type: none"> • Include an explanatory note regarding permanence issues • Possibly include an explanatory note about double-counting and the role of market mechanisms

Clause	Topic	Comment/suggested change
6	Services	Although the PAS is agnostic on its application to goods or services, there is a general orientation towards issues associated with goods. Further, selective, treatment of services (particularly boundary issues and the importance of embodied emissions) would be beneficial
6.1	Product category rules	Remove the primary reference to PCRs, and instead have the requirements refer to 'international sector guidance' or similar. This will allow broad recognition of the most relevant sector guidance, be it PCRs, industry rules, etc.
6.2	Partial GHG assessment	Change the boundary to be up to the point of leaving the gate of the producer (or remove reference to this and let the user decide) Correct the current text to clarify that use-phase emissions are not required for partial assessment
6.4.8	Use phase and functional unit	Adjust the meaning of use-phase food waste. Currently, the required raw materials due to waste at the production/retail stages are scaled up – but use-phase waste is not treated in the same way. This is slightly odd, as it could be argued that the functional unit of a loaf of bread is 100 g consumed, not 100 g brought home – the former footprint would feasibly include the 30% wastage rate and therefore be 30% higher, the latter would just include emissions from disposing of the 30% wasted
7.3	Primary data requirement	The '10% rule' is there to prevent (say) retailers relying solely on secondary data; however, it does create difficulties for highly complex supply chains. Ensure that the wording is clear – 10% of upstream emissions. Consider alternative mechanisms for achieving the same outcome
8	Allocation	Give consideration to relaxing the rules a little, keeping economic allocation as the preference and using others only in exceptional circumstances
8.2	Waste	Clarify that waste that goes on to produce energy is not a waste but an energy co-product
8.3	Combined heat and power	Remove the current accounting rules, and make an emissions allocation based on the value of the energy produced (less system emissions are avoided where exported)
5.3.1 and 5.3.2	Biogenic carbon	Correct the mistake in PAS 2050 that seems to ignore emissions from biogenic carbon used in bio-fuel Change the accounting mechanism from 'zero in, zero out' to '-1 in, 1 out'
8.5 and 8.6	Recycling	Recognize the two different types. This reflects practice, consistent with WRI/WBCSD

Reports from Defra studies

Defra provided BSI with two reports, commissioned to test the practical use of PAS 2050 in order to inform the review.

1. Trialling PAS 2050

This research was commissioned and funded by Defra and undertaken by Environmental Resources Management (ERM).

Three trials were completed by:

- IBM – the carbon footprint of the Whole Farm Approach (WFA) IT service
- AkzoNobel – the carbon footprint of Dulux white matt paint
- Johnson & Johnson (J&J) – the carbon footprint of baby wipes

Each of the trials required completion by the company of an entire life cycle quantification of GHG emissions from the selected product or service, using PAS 2050, with guidance provided by ERM.

The reasons for undertaking these trials were identified as:

- To monitor and record the practical experience gained by the company in implementing PAS 2050, and to identify any particular difficulties encountered
- To prepare any recommendation for possible change or improvement that could assist a future revision of PAS 2050 and its associated guide

The companies which undertook the trialling of PAS 2050 were subsequently asked to provide feedback on their experiences. The main points of feedback are summarized below.

With respect to the quantification methodology, the report analyses the application experience on a stage-by-stage basis and draws attention to particular

areas of difficulty for attention in a future revision, as follows:

- Materiality assessment
 - Requirement for a more practical approach to be identified; the current approach is seen as self-defeating
- Primary and secondary data requirements
 - Acknowledges both the benefits and the difficulties of locating and collecting data and highlights the need for:
 - a publicly available source of PAS-consistent emission factors for general flows such as electricity, transport and waste management
 - the accessibility of widely available, neutral databases (e.g. the European Reference Life Cycle Data System (ELCD))

and

- With regard to sector-specific supplementary requirements (PCRs), the report highlights the need to give further attention to sector/category-specific provision, although it is unclear whether this should be as guidance or as supplementary requirements. The study also draws attention to the need for governance in the development of PCRs.

This Defra report is, however, quite clear in its suggestion that enhancement of the PAS 2050 Guidance would be of considerable benefit.

Topics specifically identified as being likely to benefit from further attention are:

- Data collection, especially:
 - the construction of data collection questionnaires
 - the structure of supplier interviews
 - the interpretation and handling of secondary data sources
- Common problems, data sources and calculation methods relating to more generic topics, such as:
 - transport
 - storage and retail
 - waste management

Further acknowledging the need for secondary data, the report draws attention to the need for clarification of the relationship between the published Defra/DECC emission factors and how these relate to the particular requirements of the PAS 2050 methodology.

2. Comparing the PAS 2050 and Carbon Trust 'Footprint Expert' – requirements for product carbon footprinting – recommendations for BSI

This research was undertaken in order to make direct comparison between PAS 2050 in its role as a tool for businesses seeking to quantify GHG emissions and/or to determine informal carbon footprints for products or services and the toolkit called Footprint Expert™ (FPX), developed and provided by the Carbon Trust Footprinting Company for the purpose of improving comparability between communicated footprints.

This report offers some findings and recommendations with regard to potential PAS 2050 amendments, suggesting that this would update PAS 2050 in line with the more tightly defined FPX approach. In this connection, the report highlights in particular:

- The development of product- or sector-specific rules or guidance for many, but not necessarily all, sectors. However, no sectors were specifically identified
- The inclusion of rules on complementary products in use, for all sectors
- The inclusion of rules on product differentiation, relevant to all sectors
- The inclusion of more specific rules on sampling, of interest to all sectors but to varying degrees
- The inclusion of more specific/flexible rules on the treatment of recycling, required by all sectors
- The provision of common data, methods or guidance for transport, storage and retail, cooking and refrigeration, and end of life, relevant to all sectors

A strong theme here is that many of these recommendations would generally be better dealt

with through the development of product- or sector-specific rules or guidance, although without identifying any particular sectors that would benefit from such rules/guidance.

Product specific rules (PSRs) have, however, been developed as part of the Carbon Trust Footprint Expert programme, under the governance of the Carbon Trust Footprinting Company, in order to avoid the emergence of potentially conflicting sets of rules. In this respect, the approach is not dissimilar from that being taken in Japan.

Comparison – PAS 2050/ ISO 14067 and the WRI/WBCSD Product Standard (Appendix B)

Since the publication of PAS 2050 in 2008, both ISO and WRI/WBCSD have embarked on a programme to add quantification of emissions from goods and services to their portfolio of specifications.

ISO is currently developing ISO 14067, *Carbon footprint of products — Requirements and guidelines for quantification and communication* (availability not before 2013), and WRI/WBCSD is in the final stages of developing a new *Product Accounting and Reporting Standard* (available autumn 2011).

The most recent drafts of the GHG Protocol Product Standard and ISO 14067 (Committee Draft 2) were still works in progress at the time of writing of this report, but have been made available to the Steering Group for comparison with PAS 2050. To facilitate this, arrangements have been made for experts participating in the development of both of these documents to also participate in the revision of PAS 2050.

A table comparing the clauses of all three documents has been provided by experts working on the development of all three documents (see Appendix B), and this identifies the following aspects as having the potential for harmonization (Table 5).

Table 5: Comparison of clauses in PAS 2050/ISO 14067 and in the GHG Protocol Product Standard

Topic	Potential for harmonization
Terminology	Potential for harmonization (but this is a minor point as it has no impact on the results)
Sector-specific supplementary requirements (PCRs)	Potential for harmonization. The differences highlight the need for consistency around PCRs. The GHG Protocol does not require PCRs to be followed (for quantification or public reporting), and is also more flexible beyond ISO 14025 ^{a)} . PCR usage under ISO 14067 and PAS 2050 is required, but it is not clear how users might interpret 'considered proper' or 'does not conflict' and whether that interpretation would be made consistently. The draft ISO 14067 requires PCRs but not programme operators for public reporting
System boundary determination	Fairly harmonized but different levels of prescription may impact the consistency between studies done following different standards
Cut-off threshold	Potential for harmonization. PAS 2050 requires scale-up to 100% of emissions from the anticipated 95%. ISO 14067 and the GHG Protocol allow exclusions, and so values may be below 100%
Time period for use-stage emissions	Potential for harmonization. PAS 2050 specifies a 100-year lifetime, while ISO 14067 and the GHG Protocol allow companies to specify and justify the time period. It is not clear if each standard is defining the same concept
Allocation	Potential for harmonization. All methods allow the use of economic allocation, but PAS 2050 does not include the other methods of allocation such as physical relationships
Treatment of recycling/reuse	Potential for harmonization
Primary data requirements and data-quality assessment	Fairly consistent
Data-quality assessment	Potential for harmonization
Uncertainty assessment	Potential for harmonization
Land use change	Direct: there is consistency between the GHG Protocol and PAS 2050 approaches. If significance was defined in ISO 14067 as land use change occurring in the past 20 years, the standards are fairly consistent. If not, there is a potential for harmonization. Indirect: potential for harmonization
Biogenic emissions	PAS 2050 takes a different approach to the GHG Protocol and ISO 14067, by not recognizing the GHG impact of either the removal or release of biogenic carbon. Although this method is different from the ISO and WRI methods, the net effect is the same
Carbon storage/sequestration	Potential for harmonization. PAS 2050 explicitly recognizes the impact of carbon storage. In ISO 14067 it is unclear what 'reported separately' means. In the GHG Protocol, embedded carbon is reported but the impact is not included in the product footprint
Delayed emissions	Inconsistent. Potential for harmonization

^{a)} BS ISO 14025, *Environmental labels and declarations — Type III environmental declarations — Principles and procedures*.

The need for elimination of unnecessary or unintentional differences between these three documents is addressed in the Conclusions and Recommendations section of this report.

Other GHG quantification initiatives

Examination was undertaken of other GHG quantification schemes that have emerged since October 2008, when PAS 2050 was first published.

It is apparent that, since the publication of PAS 2050 in October 2008, activity relating to quantification of GHG emissions from goods and services has continued to grow. New programmes have been developed in various countries, notably Japan, France, Germany, Taiwan and Korea. Also, new schemes are continuing to emerge, including one in China, which is expected to start in 2011.

The schemes currently being developed in France, Germany and Japan are seen to be of relevance to this research and the future development of PAS 2050, because they are becoming soundly based in their country of origin and have the potential to influence the development of GHG emissions quantification in other countries as cross-border trade takes the need for emissions quantification into more countries. This is already the case in Korea, which has adopted the Japanese scheme. Review of all these schemes confirms that they are taking a product- or sector-specific approach, underpinned by methodologies that have considerable synergy with that promoted by PAS 2050. The narrower scope of a product- or sector-specific scheme, however, allows for greater specificity in the requirements, which can make the standards more straightforward to apply.

The Japanese scheme, in particular, is a well-constructed, coordinated programme, with some 45 products identified for inclusion to date. Of these, 22 have submitted life cycle flow charts for approval, and just four have completed schemes approved. These

are for rice, rapeseed oil, detergent powder and potato chips.

Without exception, the schemes referred to include requirements for communication or are directly related to labelling, leaving PAS 2050 in the unique position of being the only dedicated quantification methodology capable of supporting multiple communication requirements or labelling protocols, or of acting as a reference quantification method if required.

Product/sector-specific vs generic application of PAS 2050

PAS 2050 already includes provision for the use of PCRs when judged necessary for particular products of industry sectors. However, the evidence of what is happening generally in this respect points to a possible need for additional provision.

As has already been identified, it is apparent that several countries (e.g. France, Germany, Japan and Korea) are choosing to follow a product-specific route. It is, however, notable that both the GHG Protocol Product Standard and ISO 14067 appear likely to remain generic, albeit with attention being specifically paid to the possible use of such supplementary requirements (identified as PCRs in the draft GHG Protocol Product Standard and still the subject of discussion in the draft ISO 14067).

It is also apparent that in its application of the PAS 2050 methodology, the Carbon Trust has found it beneficial to take a product-category- or product-specific approach.

This is a practical option, where the process of application is under the general control of a single entity. In that situation it is possible to exercise oversight and, to some extent, governance over the development of the PCRs or PSRs, and thus avoid unintended divergence of approach and a good measure of comparability of outcomes.

However, PAS 2050, ISO 14067 and the GHG Protocol Product Standard Protocol are, or will be, made available for use by any entity wishing to do so, without any specific controls or overarching governance and, as a result, the situation is somewhat different. If a generic document providing generally applicable requirements is considered

appropriate, and certainly that would appear to be the case currently, then to facilitate the use of PCRs, PSRs or other form of product-related requirements it is apparent that the generic documents will need to provide some direction as to how those product-related requirements should be developed.

Conclusions and recommendations

Conclusions

From the evidence of the BSI Survey, the Defra reports, and studies and other submissions, the following topics are identified for particular consideration.

Topic for review	Source of recommendation	Justification given	Particular issues
Allocation of emissions to co-products	BSI Survey User comment Inter-standard comparison	Present requirements have been a deterrent to application. Not consistent with other related standards	Considered over-prescriptive. Consider alignment with the GHG Protocol
Carbon storage in soils and delayed emissions	BSI Survey Carbon Trust recommendations	Clarification required	No significant change envisaged, but clarification is required of the formula for treatment of delays arising from the storage of biogenic carbon, to ensure that its impact is correctly captured
Clarification in relation to use phase and functional unit	User comment	Lack of clarity	Clarify Clause 7.6
Land use change	BSI Survey Carbon Trust Survey Inter-standard comparison	High incidence of misunderstanding	Review of methodology; consider the option of simplifying it. Possible alignment with the GHG Protocol
Materiality assessment	Defra PAS 2050 application study Inter-standard comparison	Lack of clarity	Review method with a view to simplifying. Consider alignment with the GHG Protocol

Topic for review	Source of recommendation	Justification given	Particular issues
Recycling	BSI Survey Inter-standard comparison	Requirements unclear Different from the GHG Protocol	Possible resolution through alignment with the GHG Protocol
Waste	Carbon Trust recommendations Defra PAS 2050 application study	Suggestion that current requirements are likely to prove a barrier to implementation	Review requirements
PCR/sector-specific supplementary requirements	BSI Survey Carbon Trust recommendation Two Defra study reports	Given the number of instances of quantification already successfully achieved through the use of the PAS 2050 methodology, it would seem to be far from certain that all goods and/or services actually need supplementary requirements	The revised PAS 2050 should remain generic but give additional focus to the use of sector- or product-specific supplementary requirements where these are judged to be essential for satisfactory quantification to be achieved. This could be facilitated by setting out within PAS 2050 the principles for developing such essential supplementary requirements
Boundary setting	BSI Survey	Insufficient focus on services	Lack of an example
Treatment of bio-carbon	User comment Carbon Trust recommendation	Possible error in PAS 2050 with respect to biogenic carbon used in bio-fuel Lack of clarity	Review/correct error. Re-examine the accounting mechanism
Treatment of capital goods	BSI Survey	Suggestion that capital goods should be included for some product types	Reconsider blanket exclusion
Variation of product over time	BSI Survey User comment	Lack of clarity	Clarify
Use of secondary data	BSI Survey Defra PAS 2050 application study	Secondary data difficult to locate/obtain	Little to be done from within PAS 2050 but possible additional direction to external sources (Specification and Guide)

This revision should be undertaken first and foremost to improve the application and robustness of PAS 2050. As a secondary consideration, an attempt should be made to reduce, or preferably eliminate,

areas of unintended or unnecessary difference between PAS 2050 and the draft ISO and WRI/WBCSD counterparts. The topics for particular consideration in this respect have been identified as:

- Terminology
- Sector-specific supplementary requirements (PCRs)
- System-boundary determination
- Cut-off threshold
- Time period for use-stage emissions
- Allocation
- Treatment of recycling/reuse
- Primary data requirements and data-quality assessment
- Uncertainty assessment
- Land use change
- Biogenic emissions
- Carbon storage/sequestration
- Delayed emissions

However, care will be necessary to ensure that the reliability and robustness of PAS 2050 is not undermined in order to achieve the looked for harmonization.

One particular area of difference between PAS 2050 and the other two generic specifications is that PAS 2050 does not include requirements for communication of quantification outcomes. This is readily apparent from observation. However, neither the BSI Survey nor any of the other studies or reports that have contributed to this research have identified this absence as a deficiency in PAS 2050.

Despite the fact that all other methodologies include communication requirements, there has been no recorded evidence of any expectation that PAS 2050 should follow suit, and the conclusion drawn in this report is that PAS 2050 should continue to fulfil its role as a quantification methodology only, but that it needs to be explicit about its role in relation to any communication of results.

Recommendations

PAS 2050 continues to have a role in the quantification of life cycle GHG emissions from goods and/or services, and is likely to do so for the immediate future. It would therefore be beneficial if PAS 2050

could be revised as quickly as possible, commensurate with the observance of the credibility of the PAS consensus-based process and delivery of a second edition that has addressed, as far as may be possible, the criticisms levelled at the first edition.

In respect of the topics identified as having contributed to decisions not to implement PAS 2050, the following possibility for action is identified:

- Complexity of process – attempt to simplify or better explain the steps of the methodology
- Availability of GHG emissions data – not correctable from within PAS 2050, but could be influenced by the inclusion of reference to more data resources, if such can be identified
- Use of other methodology – possibly influenced by improvement to PAS 2050 resulting from current revision
- Lack of demand from customers – can PAS 2050 be changed in a way that could increase awareness and demand?
- Waiting for ISO 14067 or the GHG Protocol Product Standard – possibly influenced by improvement to PAS 2050

It is strongly recommended that all the items identified in the conclusions be addressed for possible clarification or revision, as part of this review. This includes all of the following:

- Allocation of emissions to co-products
- Assessment period/time boundary
- Biogenic emissions
- Capital goods
- Carbon storage in soils and delayed emissions
- Clarification in relation to use phase and functional unit
- Land use change – direct and indirect
- Materiality assessment (GHG emissions excluded 1% materiality rule)
- Recycling/reuse – possible resolution through alignment with the GHG Protocol Product Standard
- PCRs/sector-specific supplementary requirements
- Services – enhance/clarify boundary setting

- Secondary data – little to be done from the PAS, but possible additional direction to useful sources from the Guidance
- Soil carbon change
- Variation of product over time – take account of the points raised and attempt to clarify
- Verification
- Waste – review to ensure not over-prescriptive
- Weighting factors

It is particularly important that the resulting specification is seen to be the product of a process that is adequately informed and appropriately consultative in order to retain its credibility.

Furthermore, based on the conclusions outlined above, it is recommended that the revision should not seek to extend the scope of PAS 2050 to include requirements for communication and that, in line with the recommendations of the Defra studies, the revised text should avoid the suggestion that PAS 2050 is an appropriate tool for comparison purposes.

As discussed above, the revision should take the opportunity to eliminate as much unnecessary difference between it and ISO 14067 and the GHG Protocol Product Standard as may be achievable.

Attention is drawn to the list of topics, given in the Conclusions section of this report, for which it is considered possible to achieve some harmonization.

Finally, this report recommends that PAS 2050 should remain generic in application but that an attempt should be made to include a set of principles capable of giving direction to the development of sector-specific, supplementary requirements for use in conjunction with PAS 2050, where such supplementary requirements are judged to be essential.

Closing note: *Guide to PAS 2050*




From the responses to the BSI Survey, as well as the conclusions and recommendations of the Defra studies, this research supports the need for enhanced guidance on and more examples of the application of PAS 2050.

As PAS 2050 is being reviewed, there will obviously be areas within the Guide that will need to be updated so that the two documents continue to align. BSI and Defra will appraise these requirements and determine the best course for taking this forward.

Appendix A










BSI Survey outcomes

1. What is the size of your organization?










		Response (per cent)	Response (count)
1–10 employees		23.1%	235
11–100 employees		19.6%	200
Over 100 employees		57.3%	583
		Answered question	1018
		Skipped question	0

2. Which of the following best describes your organization's primary activity?

		Response (per cent)	Response (count)
Agriculture, hunting and forestry	<input type="checkbox"/>	3.9%	40
Charity, non-profit, non-governmental organization	<input type="checkbox"/>	2.4%	24
Chemicals manufacture	<input type="checkbox"/>	3.4%	35
Construction	<input type="checkbox"/>	3.2%	33
Consulting and professional services	<input checked="" type="checkbox"/>	30.3%	308
Education	<input type="checkbox"/>	6.6%	67
Electrical and optical equipment manufacture	<input type="checkbox"/>	2.3%	23
Financial services	<input type="checkbox"/>	0.8%	8
Food and beverage	<input type="checkbox"/>	5.8%	59
Government	<input type="checkbox"/>	4.4%	45
Healthcare and social work	<input type="checkbox"/>	0.2%	2
Hotels and restaurants	<input type="checkbox"/>	0.2%	2
Information technology (hardware and software)	<input type="checkbox"/>	2.6%	26
Machinery and equipment manufacture	<input type="checkbox"/>	2.1%	21
Media services	<input type="checkbox"/>	0.4%	4
Medical devices manufacture	<input type="checkbox"/>	0.4%	4
Metal products manufacture	<input type="checkbox"/>	1.5%	15
Mining and quarrying	<input type="checkbox"/>	0.2%	2
Other manufacturing	<input type="checkbox"/>	3.4%	35
Publishing and printing	<input type="checkbox"/>	0.8%	8
Pulp, paper and paper products manufacture	<input type="checkbox"/>	1.2%	12
Real estate	<input type="checkbox"/>	0.5%	5

		Response (per cent)	Response (count)
Rubber and plastic products manufacture		0.8%	8
Telecommunications		0.7%	7
Textiles manufacture		0.9%	9
Transport and transport equipment		1.1%	11
Transport equipment manufacture		0.2%	2
Utilities (electricity, gas and water supply)		1.4%	14
Wholesale and retail trade		1.9%	19
Wood manufacture		0.3%	3
Other (please specify)		16.4%	167
		Answered question	1018
		Skipped question	0

3. Where are you based?

		Response (per cent)	Response (count)
UK		38.3%	390
Europe		26.2%	267
North America		8.9%	91
Latin America		4.8%	49
Africa		2.4%	24
Middle East		0.7%	7
Southeast Asia		4.4%	45
Asia Pacific		10.0%	102
Australasia		4.2%	43
		Answered question	1018
		Skipped question	0



4. What was your primary reason for downloading a copy of PAS 2050?

		Response (per cent)	Response (count)
To implement the standard in my organization		12.8%	97
For reference		37.6%	286
To find out what the standard was about		34.6%	263
I was required to obtain a copy by a customer (business or consumer) or government policy		2.5%	19
I thought I was getting something else		0.5%	4
Other (please specify)		12.0%	91
Answered question			760
Skipped question			258




5. Have you used PAS 2050 to measure the GHG footprint of your products and/or services?

		Response (per cent)	Response (count)
Yes, we are following PAS 2050		17.5%	133
Partially, but there are some areas we need to work on		32.4%	246
No, we had difficulties using PAS 2050 and couldn't meet the requirements		7.6%	58
No, we are using a different methodology		17.0%	129
No, we decided not to implement PAS 2050 because...		25.5%	194
Answered question			760
Skipped question			258
















6. If you are using a different methodology from PAS 2050, please specify which one and why

		Response (per cent)	Response (count)
Not using a different methodology		64.1%	487
We are using ... because ...		35.9%	273
Answered question			760
Skipped question			258










7. Did you find PAS 2050 clear, user friendly and easy to understand?

		Response (per cent)	Response (count)
Yes		43.4%	330
Somewhat		52.5%	399
Not at all		4.1%	31
How can PAS 2050 be made clearer and easier to use?			158
Answered question			760
Skipped question			258








8. If you have not used PAS 2050, which of the following factors contributed to your decision not to use it? Please select all that apply...

		Response (per cent)	Response (count)
This question is not applicable (we are using PAS 2050)		29.3%	223
Too expensive to apply		7.6%	58
Complexity of process/PCF assessment		11.3%	86
Too complex for size of our organization		10.7%	81
Organizational culture		6.1%	46
Lack of management buy-in		7.0%	53
There is no internal interest in our organization's GHG emissions		4.7%	36
No demand from customers (business or consumer)		16.4%	125
Do not/did not have the necessary expertise		7.9%	60
Use another methodology than PAS 2050		17.1%	130
Waiting for ISO and/or WRI-WBCSD to publish their methodologies		15.8%	120
Not enough GHG emissions data readily available across our supply chain		18.8%	143
Not enough guidance/lack of supporting tools		9.7%	74
Don't know		4.7%	36
Other (please specify)		15.4%	117
Answered question			760
Skipped question			258

9. Where has your organization used PAS 2050? Please select all that apply...

		Response (per cent)	Response (count)
UK		38.0%	124
Europe		34.7%	113
North America		12.6%	41
Latin America		9.5%	31
Africa		5.2%	17
Middle East		2.5%	8
Southeast Asia		8.3%	27
Asia Pacific		14.4%	47
Australasia		9.8%	32
Answered question			326
Skipped question			692

10. What were the main drivers for your organization to measure the GHG emissions associated with its goods and services? Please select all that apply...

		Response (per cent)	Response (count)
To identify 'hotspots' and improvement opportunities		47.1%	173
Our organization fundamentally believes measuring our GHG footprint is the right thing to do		35.7%	131
PR – raising the profile and recognition of the organization		27.8%	102
Customer (business or consumer) pressure and/or demand		33.0%	121
Peer pressure (i.e. our competitors are using it)		9.8%	36
To meet legislative, regulatory or government policy requirements		16.9%	62
Other (please specify)		18.3%	67
Answered question			367
Skipped question			651







11. Have you had any difficulties applying PAS 2050? If so, what problems have you encountered? Please be as specific as you can, including references to specific clauses where possible...

	Response (count)
	180
Answered question	180
Skipped question	838








12. Is anything missing that you require to enable you to better apply PAS 2050? Please be as specific as possible...

	Response (count)
	149
Answered question	149
Skipped question	869

13. In the development of PAS 2050 the following topics were highlighted for future attention. Please indicate which, if any, of these you feel requires special attention in the 2010 revision. Please select all that apply...

	Response (per cent)	Response (count)
The application of a multiplier for aircraft emissions 	29.5%	95
Indirect land usage change 	40.1%	129
Carbon storage in soils 	43.8%	141
Emissions arising from capital goods 	39.4%	127
Reference to ILCD as a source of secondary data 	23.0%	74
Treatment of recycling 	67.7%	218
Answered question		322
Skipped question		696

14. What benefits, if any, have you realized from using PAS 2050? Please select all that apply...

		Response (per cent)	Response (count)
Reducing greenhouse gas emissions		42.9%	135
Realized cost savings and efficiencies		32.4%	102
Better understanding of the organization's processes		52.7%	166
As a route to becoming carbon neutral		33.7%	106
Improved the image of our organization		36.2%	114
Increased sales		7.0%	22
Other (please specify)		19.0%	60
		Answered question	315
		Skipped question	703

Appendix B

Comparison – PAS 2050/ISO 14067 and the GHG Protocol Product Standard

Topic	GHG Protocol Product Standard (November 2010 draft)	ISO 14067 (October 2010 draft)	PAS 2050 (2008 edition)	Noted differences and harmonization potential ^{a)}
General topics				
Goals	To provide requirements and guidance for companies and other organizations to prepare and publicly report GHG inventories of products, with the goal of reducing GHG emissions	Part 1: to provide principles and requirements for studies to quantify the carbon footprint of a product (CFP) Part 2: to provide principles and requirements for the communication of a CFP	To provide a clear and consistent method for the assessment of life cycle GHG emissions, providing benefits to suppliers and consumers of goods and services including: (1) internal assessment, (2) product performance benchmarking, (3) assistance in product design and supply chain decisions, (4) standardized approach for comparison	The GHG Protocol deals with assessment and reporting. ISO 14067 and PAS 2050 deal with assessment only. However, ISO 14067 also deals with communication, and <i>The Carbon Trust Code of Good Practice</i> deals with reduction and communication for PAS 2050
Principles	Relevance, completeness, consistency, accuracy, transparency	Part 1: life cycle perspective, relative approach and functional unit, iterative approach, priority of the scientific approach, relevance, completeness, consistency, accuracy, transparency, avoidance of double counting Part 2: participation, comprehensiveness, significance, fairness, life cycle basis	Relevance, completeness, consistency, accuracy, transparency	Only minor differences in common principle definitions

<p>Product comparison</p>	<ul style="list-style-type: none"> ● The standard supports performance tracking of a product over time ● For product labelling, performance claims by third parties, consumer and business decision-making based on comparison of two products, and other types of product comparison, additional specifications are needed ● Comparative assertions are not supported by the standard 	<p>Part 1 : not intended to support comparisons</p> <p>Part 2: provides requirements and guidance to ensure comparability, reliability and comprehensiveness of the communication of a CFP</p>	<p>The standard is intended to support comparison of GHG emissions between products, and to provide a common basis for communication of this information. However, this PAS does not specify requirements for communication (except use profile)</p>	<p>Potential for harmonization on what additional specifications are needed for communication of comparisons</p>
<p>Product category rules (PCRs)</p>	<p>Encourages users to look to sector-specific guidance and product rules, when available and in conformance with the product standard. Provides guidance on additional specifications needed for comparisons that can be addressed in product rules</p>	<p>Part 1 : PCRs shall be used when they:</p> <ul style="list-style-type: none"> ● Exist ● Are in accordance with ISO 14025 ● Comply with the requirements of this standard ● Are considered proper <p>Part 2: the communication of the carbon footprint to consumers shall fulfil specific product group requirements as defined by the PCR developed in accordance with the standard</p>	<p>ISO 14025-compliant PCRs:</p> <ul style="list-style-type: none"> ● Shall be used in boundary setting when the system boundary in the PCR does not conflict with the system boundary established in PAS 2050 Clause 6 – as the first preference (in a hierarchy) for determining the use profile 	<p>Potential for harmonization. The differences highlight the need for consistencies around PCRs. The GHG Protocol does not require PCRs to be followed (for quantification or public reporting), but is more flexible beyond ISO 14025. PCR usage under ISO 14067 and PAS 2050 is required, but it is not clear how users might interpret ‘considered proper’ or ‘does not conflict’ and whether that interpretation would be made consistently. ISO 14067 requires PCRs but not program operators for public reporting</p>

^{o)} Harmonization potential is noted when variation between the standards exist. It is not meant to reflect any opinion on which method is preferred.

Topic	GHG Protocol Product Standard (November 2010 draft)	ISO 14067 (October 2010 draft)	PAS 2050 (2008 edition)	Noted differences and harmonization potential
Method: attributional vs consequential	Companies shall use the attributional approach (with the use of system expansion for allocation permitted with the use of attributional data)	Not specified, but refers to average data in many places, so it is assumed attributional in most cases (also allows system expansion and indirect LUC)	Uses an attributional approach (but also allows system expansion in limited circumstances)	Consistent on the attributional approach for product carbon footprints (indirect LUC discussed separately below)
Unit of analysis	Functional unit for all products, except intermediate products where the function is unknown. In this case reference flow is used	Functional unit (no requirements or guidance on unit of analysis for partial carbon footprint)	Functional unit (no requirements or guidance on unit of analysis given for business-to-business communication of intermediate products)	Potential for harmonization on unit of analysis for cradle-to-gate assessments
Product terminology	Product inventory	CFP	GHG assessment	Potential for harmonization (but minor point as it has no impact on the results)
Boundary and allocation				
Cradle-to-grave vs cradle-to-gate	Both allowed	Both allowed (called partial carbon footprint)	Both allowed	Consistent, no need for harmonization
System boundary inclusions	All attributable processes (process directly connected to the product through material and energy flows)	Shall include all emissions of those unit processes in the defined system boundary (consistent with the goal of the study) that have the potential to make a significant contribution	Includes raw materials, energy, manufacturing and service provision, operations of premises, transport, storage, use phase and final disposal	Fairly harmonized, but different levels of prescriptiveness may impact on consistency between studies done following different standards
System boundary recommendations/allowable exclusions	Non-attributable processes (capital goods, corporate activities) are recommended for inclusion if relevant	None listed	Excludes capital goods, human energy inputs, customer travel, employee commuting, and animals providing transport services	Fairly harmonized, but different levels of prescriptiveness may impact on consistency between studies done following different standards

<p>Cut-off threshold</p>	<ul style="list-style-type: none"> ● When a data gap exists, companies can estimate whether a process can be excluded based on environmental insignificances ● Companies are required to disclose their criteria for insignificance in the inventory report (rule of thumb of 1% given in the standard, but not required) ● All excluded processes are required to be disclosed and justified in the inventory report 	<p>Omissions allowed only if they do not significantly change the overall conclusion of the study based on a consistent cut-off criterion</p>	<p>All sources of emissions anticipated to make a material contribution (i.e. contribute more than 1% of the anticipated life-cycle GHG emissions (Clause 3.33)). The assessment of GHG emissions shall include at least 95% of the anticipated life-cycle GHG emissions of the functional unit; where a single source of GHG emissions accounts for more than 50% of the potential life-cycle GHG emissions of a product, the 95% threshold rule shall apply to the remaining GHG emissions associated with the anticipated life-cycle GHG emissions of the product (Clause 6.3). 100% of emissions shall be included by scaling up from 95 % of anticipated emissions</p>	<p>Potential for harmonization. PAS 2050 requires scale-up to 100% of emissions from the anticipated 95%. ISO 14067 and the GHG Protocol allow exclusions, so the result may be below 100%</p>
<p>Assessment period/time boundary</p>	<p>The time boundary for the total life cycle of the product shall be reported, and the time boundary for individual life cycle stages should be reported when applicable</p>	<p>The time period for assessment shall be specified and justified. If the time period for the use and end of life occur over more than 10 years, the time period for each emission and removal during that stage needs to be reported separately</p>	<p>All emissions arising from the product over the 100 years following the formation of the product (the assessment period) shall be included</p>	<p>Potential for harmonization. PAS 2050 specifies a 100-year lifetime, while ISO 14067 and the GHG Protocol allow companies to specify and justify the time period. It is not clear if each standard is defining the same concept</p>
<p>Allocation</p>	<p>Includes the same methods as ISO 14044, although the hierarchy has been replaced with guidance to encourage the use of the most applicable allocation method</p>	<p>Same methods as ISO 14044</p>	<p>Same methods as ISO 14044 to avoid allocation, and when avoidance is not feasible, economic value allocation shall be used</p>	<p>Potential for harmonization. All methods allow the use of economic methods, but PAS 2050 does not include the other methods of allocation such as physical relationships</p>

Topic	GHG Protocol Product Standard (November 2010 draft)	ISO 14067 (October 2010 draft)	PAS 2050 (2008 edition)	Noted differences and harmonization potential
Recycling/reuse	Two methods to choose from: 100/0 input (cut-off) method and 0/100 output (closed-loop approximation) method. Companies may also use another method if it is disclosed and justified in the inventory report	Same approach as ISO 14044	For recycled inputs originating from the same product system, the GHG assessment shall reflect these emissions using the calculation methodology provided in PAS 2050 (Clause D.1). For product reuse, the life-cycle GHG emissions, excluding the use phase, shall be divided by the anticipated number of times the product is reused. For other times, ISO 14044 should be followed. In practice, implementation of PAS 2050 follows a 100/0–0/100 approach	Potential for harmonization
Data and data quality				
Primary data requirement	Primary data shall be collected for all processes under the financial control and management control (as defined by the GHG corporate protocol) of the company undertaking the product inventory	Primary data shall be collected for all individual processes under the financial and operations control of the organization undertaking the study, and shall be representative of the processes for which they are collected	Primary activity data shall be collected from those processes owned, operated or controlled by the organization implementing PAS 2050. The primary activity data requirement shall not apply to downstream emission sources (Clause 7.3). The requirement to obtain primary activity data shall not apply where implementing the requirement would necessitate the physical measurement of the GHG emissions (e.g. measuring CH ₄ emissions from livestock or N ₂ O emissions from fertilizer application (Clause 7.3))	Fairly consistent

Data quality assessment	Activity data, emission factors and direct emissions data shall be assessed by data quality indicators during data collection	A CFP study should use data that reduce bias and uncertainty as far as practicable by using the best quality data achievable (data quality indicators listed)	Establishes requirements for the preference of specific data-quality attributes for both primary activity and secondary data through the application of data-quality rules. No requirement for the reporting of data quality	Potential for harmonization
Uncertainty assessment	A qualitative statement on sources of inventory uncertainty and methodological choices shall be reported	The CFP study shall include a quantitative or qualitative assessment of uncertainty	Not required; uncertainty is minimized through the application of data-quality requirements	Potential for harmonization
Input/output vs process data	Input/output data is allowed as a form of secondary data	Not specified	Input/output data should be used for screening purposes (Clause 6.3). No other preference is stated	Potential for harmonization
Treatment of electricity	No specific requirements or guidance (although do require the cradle-to-gate inventories of all material and energy flows)	<ul style="list-style-type: none"> ● Shall include cradle-to-gate emissions for electricity ● When a supplier can deliver a specific electricity mix and guarantee no double counting that data can be used ● If renewable energy sources are already sold/exported as green electricity, they should be excluded from the mix, to avoid double counting 	<ul style="list-style-type: none"> ● Emissions associated with the provision and use of energy shall be included in the emissions arising from the energy supply systems ● Electricity and heat from a stand-alone source shall use an emission factor relevant to that source ● Electricity and heat from large energy transmission systems shall use average secondary data ● Renewable energy factors can only be used if not double counted 	Potential for harmonization (ISO 14067 and PAS 2050 are consistent)

Topic	GHG Protocol Product Standard (November 2010 draft)	ISO 14067 (October 2010 draft)	PAS 2050 (2008 edition)	Noted differences and harmonization potential
Assurance and reporting				
Assurance/verification	The product GHG inventory shall be assured by a first or third party	Part 1: not discussed Part 2: if the results of a carbon footprint as reported according to Part 1 are to be communicated to the consumer, the communication, including the report, shall be verified by an independent third party	A conformity assessment (independent third party, other party or self-verification) is required to claim conformance with PAS 2050	Potential for harmonization on the role of the first part (self) verification and the need for third-party verification based on how the results are communicated
Reporting	A public GHG inventory report that is in accordance with the product standard shall follow the key accounting principles and include the following information (specific requirements not included here)	Part 1: includes reporting requirements, where the purpose of the report is to demonstrate that the provisions of this international standard have been followed Part 2: includes additional requirements specific to various types of public communication	Supports the assessment of life-cycle GHG emissions that can be reported and communicated to stakeholders, including consumers, but not does include a requirement for communication	Requirements are not inconsistent, but levels of prescriptiveness vary, which may cause inconsistencies
Offsets	Not allowed for inclusion in the inventory results	Not allowed for inclusion	Not allowed for inclusion (Clause 5.7)	Consistent, no need for harmonization

Technical topics			
Direct land use change	<p>Attributable land use change is required for inclusion. The assessment of the impact of land use change shall include all direct land use change occurring 20 years (or the length of one harvest for managed wood) prior to the time of harvest, and 1/20th (5%) of the total emissions arising from the land use change shall be included in the GHG emissions of attributable products in each year over a 20-year (or the length of one harvest for managed wood) allocation period. Includes additional examples on how to estimate land use impacts when the specific land is unknown, but does default to using the worse-case scenario as described in PAS 2050</p>	<p>When significant, the GHG emissions and removals occurring as a result of direct land use change shall be assessed in accordance with the goal and scope of the study, and in accordance with internationally recognized methods such as the <i>IPCC Guidelines for National Greenhouse Gas Inventories</i></p>	<p>The assessment of the impact of land use change shall include all direct land use change occurring on or after 1 January 1990. 1/20th (5%) of the total emissions arising from the land use change shall be included in the GHG emissions of these products in each year over the 20 years following the change in land use</p>
Indirect land use change	Not included	Indirect land use change shall be considered in CFP studies, once an internationally agreed procedure exists. All choices shall be justified and reported	Potential for harmonization
Biogenic emissions	Biogenic emissions and removals shall be collected and reported	Biogenic emissions and removals shall be collected and reported	PAS 2050 takes a different approach to the GHG Protocol and ISO 14067, by not recognizing the GHG impact of either the removal or release of biogenic carbon. Although PAS 2050 is different from ISO 14067 and the GHG Protocol, the net effect is the same

Topic	GHG Protocol Product Standard (November 2010 draft)	ISO 14067 (October 2010 draft)	PAS 2050 (2008 edition)	Noted differences and harmonization potential
Product carbon storage/sequestration	<ul style="list-style-type: none"> ● If it is known that embedded carbon within the product is not released to the atmosphere during waste treatment, a company is required to disclose and justify this in the inventory report ● In a cradle-to-gate inventory, the amount of embedded carbon within the product as it leaves the inventory boundary is required to be disclosed and justified in the inventory report ● If process emissions are not released to the atmosphere due to storage, the attributable processes associated with storing the emissions are required to be included in the inventory boundary, and the amount of emissions stored is required to be noted in the inventory report 	Data on the timing of carbon storage and sequestration shall be collected and reported separately	When atmospheric CO ₂ is taken up by a product, and that product is not a living organism, the impact of this carbon storage over the 100-year assessment period shall be included in the assessment of the life-cycle GHG emissions of the product (5.4)	Potential for harmonization. PAS 2050 explicitly recognizes the impact of carbon storage. In ISO 14067 it is unclear what 'reported separately' means. In the GHG Protocol, embedded carbon is reported, but its impact is not included in the product footprint
Temporary carbon storage credit for biogenic products	No temporary carbon storage credit permitted	Data for calculation is collected, but is not specifically mentioned in the assessment	Impact of temporary carbon storage is recognized under certain circumstances (e.g. stored for more than 1 year)	Inconsistent. Potential for harmonization
Weighting factors (delayed emissions)	Weighting factors shall not be applied to the inventory results, but companies may include results with weighting factors separately	Not specifically mentioned	Allows for the calculation of the weighted average impact of emissions arising from the use phase and final disposal of products	Inconsistent. Potential for harmonization