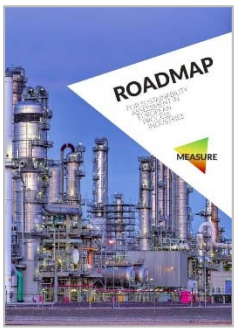
Background document

supplementing the

“Roadmap for

Sustainability Assessment in

European Process Industries”



MEASURE survey results

Authors:

M. Jones[1], A. Azapagic[1]

[1] The University of Manchester, School of Chemical Engineering and Analytical Science

An initiative from the European Community's framework programme for research and innovation H2020 [H2020/20014-2020] under grant agreement no. 636816 (MEASURE).

Version: 1.0

Published online: April 2016

Table of Content

1 Introduction

In order to identify the current usage and best practice applications of life cycle sustainability assessment within the European process industry, as well as help inform the work of the MEASURE consortium, a survey of experts was undertaken with the aim: *to identify the current state of sustainability assessment tools, techniques and approaches in different sectors of process industries with the focus on life cycle tools and methods.*

The MEASURE survey, which took the form of an online survey, followed on from an earlier survey developed jointly between the three SPIRE 4 consortia: MEASURE, STYLE and SAMT. This survey was distributed to a wide base of stakeholders. It incorporated a disperse range of topics at a low level of detail relating to the aims of the three SPIRE 4 projects. The results will be published together with the STYLE and SAMT project

The outcomes of this wide ranging survey were also used by the MEASURE consortia to inform the questions to be addressed within a more in-depth and highly targeted survey in line with the aims and objectives of the MEASURE project.

The survey took the form of a limited survey of identified experts working within the European process industry, selected based on their organisation's involvement in sustainable development activities. The experts, that included representatives from businesses, industrial associations, government organisations, academia, non-governmental organisations and consultancies, were identified by the MEASURE project partners and contacted directly.

The survey, that was available for completion between May and October 2015, was organised into the following sections:

- General information (to understand the survey sample);
- Life cycle assessment;
- Critical points due to interfaces between sectors and/or along the supply chain;
- Methodological choices;
- Current state of life cycle sustainability assessment and footprinting activities;
- From research and development to full scale; and
- Decision making with life cycle assessment.

The survey registered 67 responses of which 43 were answered sufficiently to be incorporated within any analysis of the results. This report provides an overview and qualitative assessment of the responses received to the MEASURE survey.

2 General information

Respondents to the MEASURE survey were asked to provide a range of information about the type, nature and location of the work they undertake within the field of sustainability assessment. As will be seen, the responses suggest a broad coverage of the European process industry, with respondents working in a wide range of organisations, and primarily involved in research.

2.1 Sectors within the European process industry

As can be seen in Figure 1, respondents are working within a broad range of sectors. The chemicals, consumer goods, engineering and waste sectors represented 55% of all respondents. The steel, minerals, pharmaceuticals and water sectors were also well represented with a small number of respondents working in the cement and non-ferrous metals sectors. The 'other' category represented sectors included sustainability assessment; EEE, transport, textiles; energy; secondary raw materials and recycling; agri-food; construction; machine-tooling; automotive; consultants and researchers. Among the responses provided, 40% stated that they worked across multiple sectors.

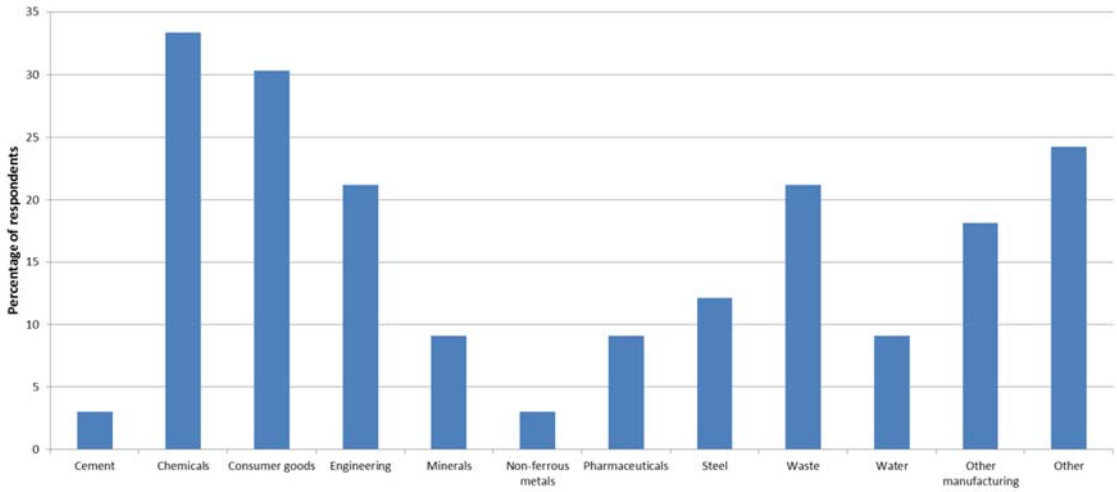


Figure 1. Business sectors represented by respondents

Whilst heavily weighted to the areas highlighted above, the sample did closely resemble the three sectors of the European process sector that MEASURE was focusing on, namely: chemicals and consumer goods; steel and automotive; and waste.

2.2 Geographical location of respondents

As can be seen in Figure 2, more than ten European countries are covered by the responses obtained, including each of the MEASURE consortia nations. The responses are heavily weighted towards Belgium and Germany (almost 50%), likely due to the large network of the MEASURE consortia members in Germany and the location of the first

MEASURE workshop in Belgium, where a large number of participants were invited to answer the survey.

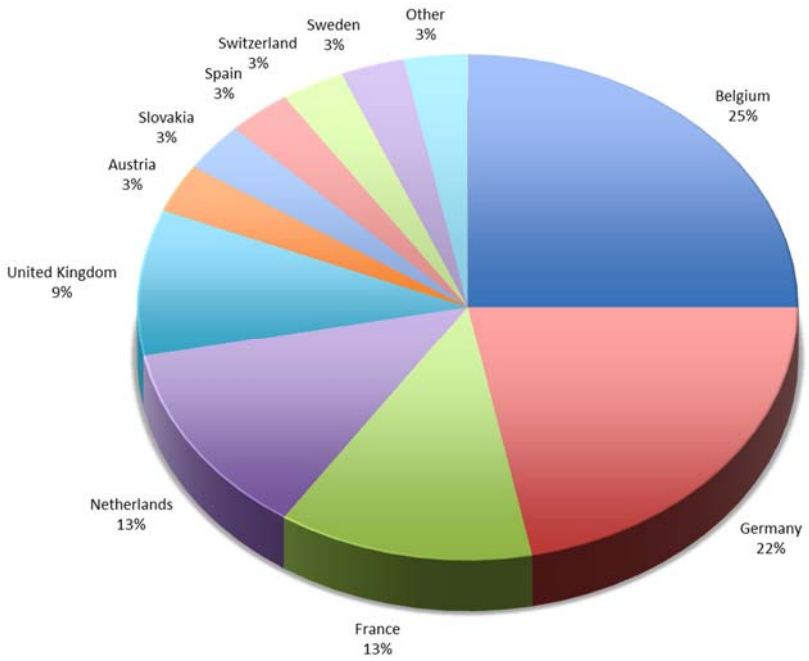


Figure 2. Geographical distribution of respondents

2.3 Roles and responsibilities of respondents

Figure 3 shows that 50% of the respondents are researchers (including senior researchers and research managers) whilst the single largest group (25%) represents mid-level managers. The size of the respondents' organisations and the number of employees they have reporting to them are not known as questions related to this matter were not included in the survey.

2.4 The nature of respondents' business

The majority of respondents reported that their organisations were either manufacturing (30%) or industrial in-house researchers (27%); consultancy (13%) and academic research (10%) were also notable. Industry associations (7%), industrial contract research (3%) and other (10%) making up the remainder (Fig. 4).

2.5 Departments driving sustainability assessment projects within organisations

Just over 40% of respondents said that they have a specific sustainability department leading their organisation's sustainability assessment projects. A further 33% replied that

their research and development departments were in charge of such projects, whilst 14% replied that it was their HSE department. The other category included respondents who stated that they had environment departments driving the issue, presumably significantly different from the sustainability department option provided, specific life cycle assessment departments and that it was driven within project teams, outside of any particular department structure.

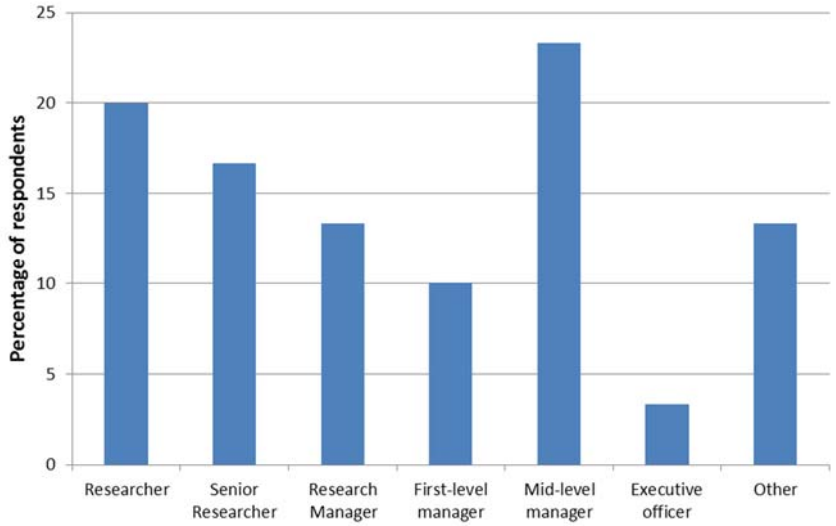


Figure 3. Position of respondents within organisations

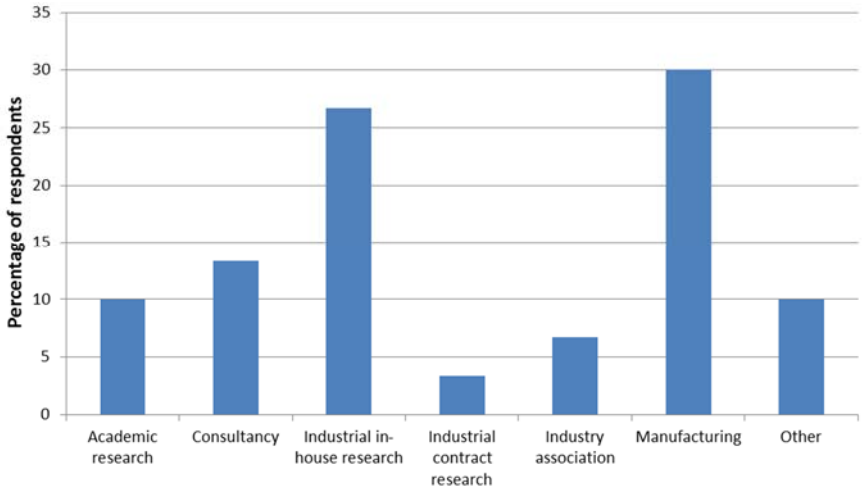


Figure 4. Types of organisation

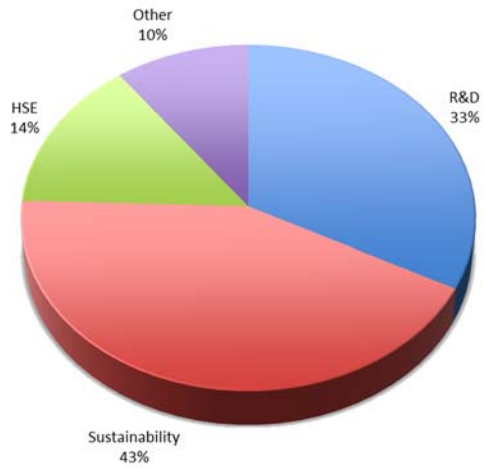


Figure 5. Departments leading sustainability assessments with organisations

3 Life cycle assessment

The MEASURE survey included a selection of questions related to the use of life cycle assessment (LCA) within organisations, focusing on how often LCA is used, the tools used and the main application of LCA within respondents' organisations.

3.1 Prevalence of LCA studies within organisations

As shown in Figure 6, over half (55%) of the respondents stated that they performed LCA on more than 30% of their turnover coverage, with almost a quarter (23%) stating that they did not perform LCA on any of their products or processes.

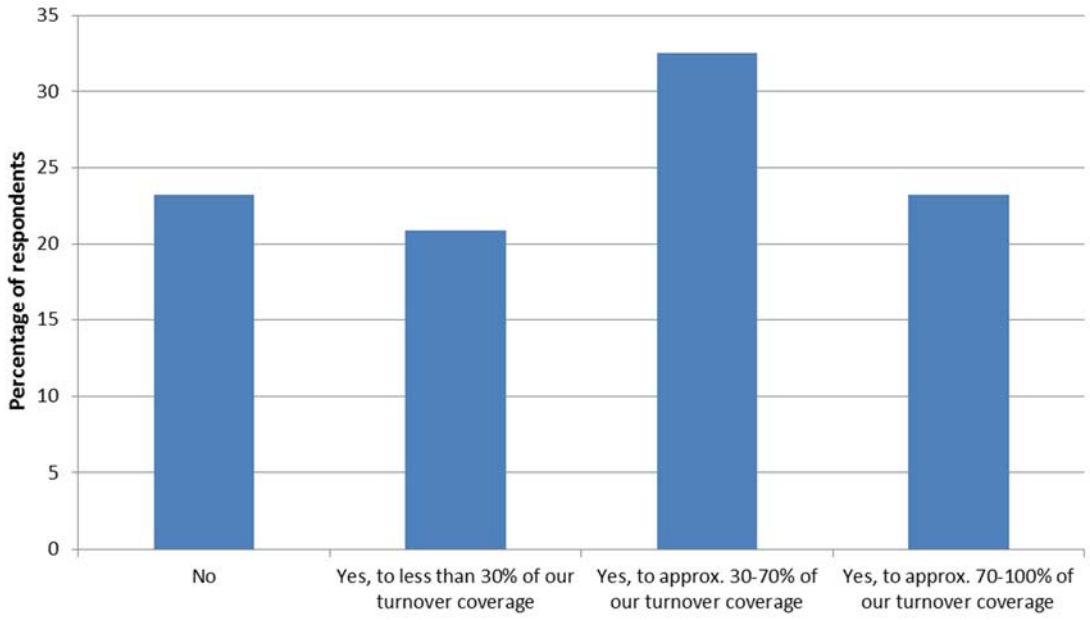


Figure 6. Are LCA studies performed on the organisation's products or processes?

3.2 Use of different LCA frameworks

Respondents were asked to identify LCA frameworks used within their work and estimate their frequency of use. Figure 7 shows that a range of LCA frameworks are used by respondents, although most notably ISO standards 14040/44, the GHG protocol and ILCD or PEF frameworks. Indeed, the ISO standards 14040/44 were reported as being 'always', 'often', or 'regularly' used by 92% of respondents whilst the GHG protocol and ILCD/PEF frameworks were reported as being 'always', 'often', 'regularly' or 'sometimes' used by approximately 60% of respondents; note that no respondents replied 'always' using the ILCD/PEF frameworks.

3.3 Main applications of LCA within organisations

Respondents were asked to identify the main reasons for conducting life cycle assessment within their organisation. Multiple responses were allowed and the results are presented in Figure 8. Most respondents conduct LCA for product/process development and improvement (76%). Then, LCA is used as a driver for innovation (59%) and as a customer requirement (59%). Marketing (48%), environmental labelling (41%), external reporting (41%) and strategic planning (38%) all scored fairly highly, whilst fewest respondents (21%) cited policy and regulations as being a primary application. Finally, 14% of respondents suggested other applications including: value propositions to support sustainable innovations; product performance evaluations; creation of raw material databases; internal stakeholders and research.

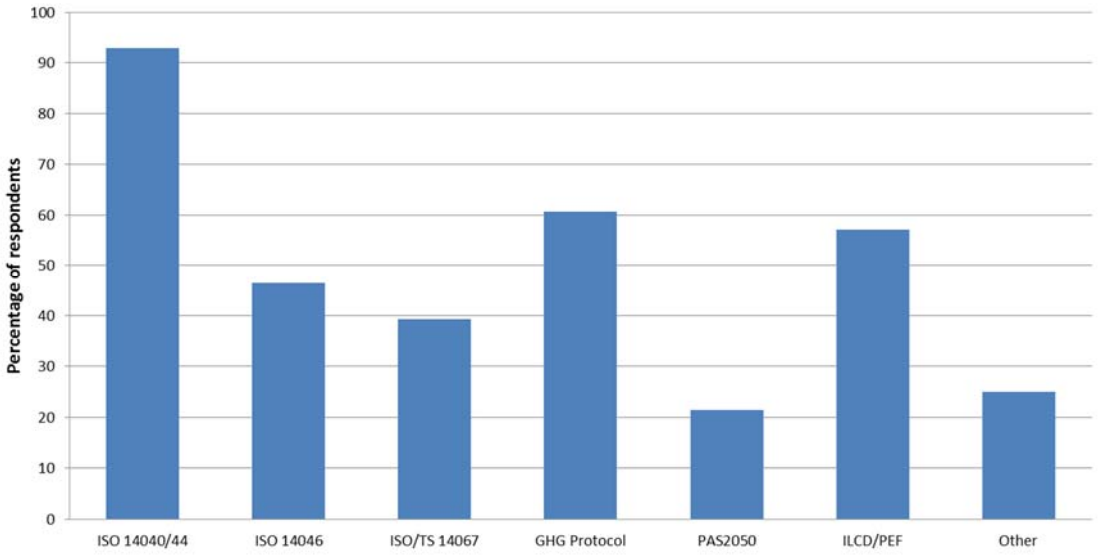


Figure 7. Which LCA frameworks are used?

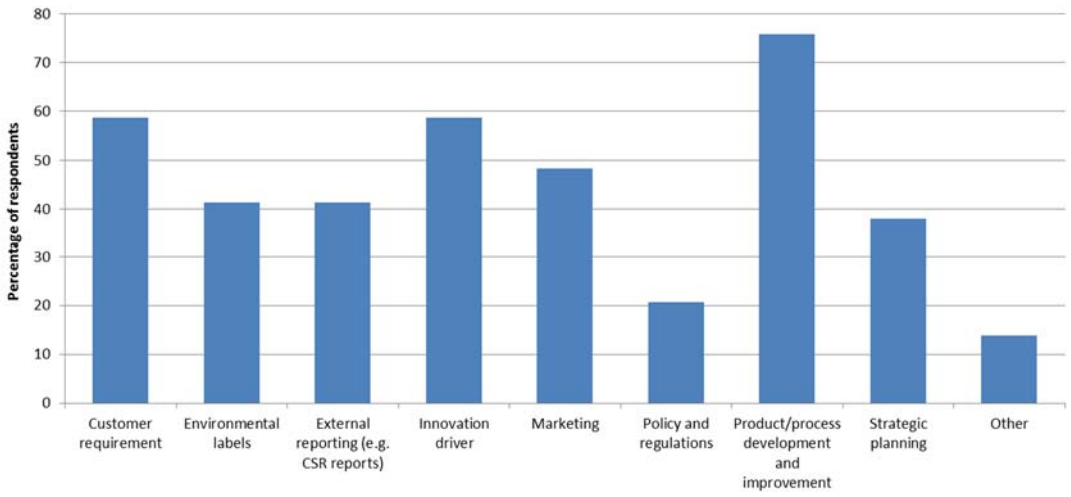


Figure 8. Main reasons for applications of LCA within organisations

4 Critical points due to interfaces between sectors and/or along the supply chain

4.1 Allocation of co-products within the supply chain

Respondents were asked to state how important it was to reach agreement about allocation methodologies at different levels within the supply chain. Figure 9 shows that the perceived importance was largely consistent across the four areas of the supply chain. Perhaps unsurprisingly, 90% of respondents felt that agreement on allocation methodology within the same company was either important or very important. A similar percentage (89%) felt the same about gaining agreement with other companies within the same sector. Almost as many respondents (81%) stated that they considered it important or very important to reach an agreement between companies operating in different sectors and mostly considered that this agreement should be standardised (77%).

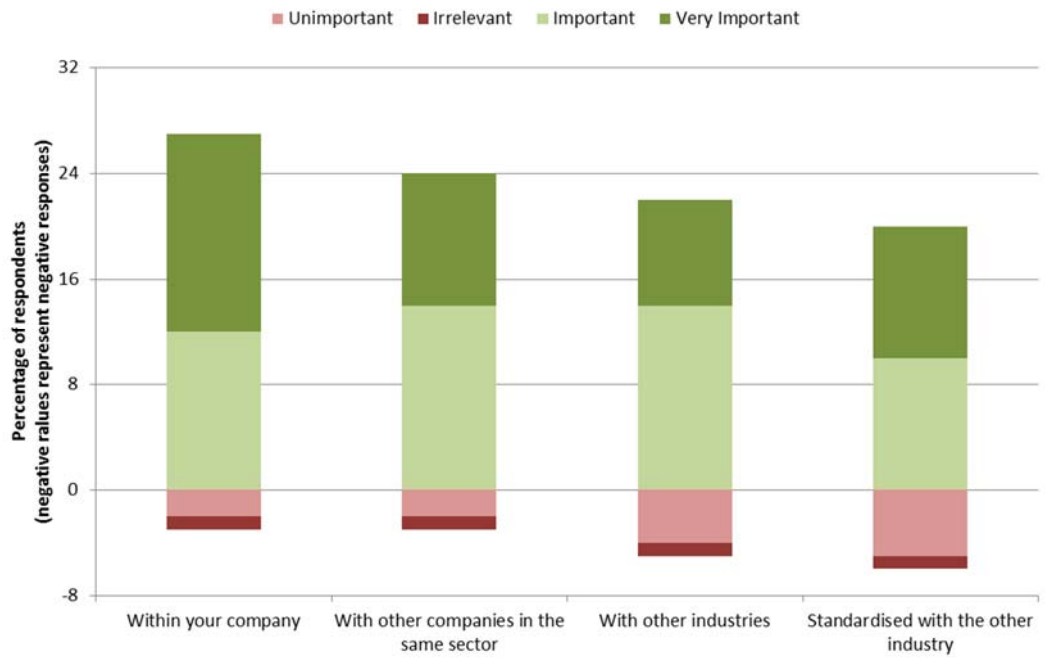


Figure 9. Importance of agreeing on allocation methodologies

4.2 Data sources and tool integration

As shown in Figure 10, respondents make use of a wide range of data sources when collecting data on the material components of their products. The majority (76%) stated that they use their own data for determining the material components of the products. The other major sources of data were literature (68%) and bill of materials (59%). Others stated that they use enterprise resource planning tools (38%), product lifecycle/data management (29%) and data from experimentation (24%). Process simulation, teardown

analysis, material data systems and computer aided design were used by between 15% and 18% of the respondents. The rest answered that they use data directly from their suppliers or generic databases.

Almost half of respondents (44%) stated that they had access to an in-house linkage software between their databases and an LCA tool (such as Umberto or GaBi). Approximately one third (32%) stated not having the linkage software, although more than half of those recognize the benefit of having it. The remaining 24% did not know whether they had access to a database/LCA linkage software tool or not.

Approximately one third (31%) stated that they had access to either a commercial or in-house link between process simulation tools (such as Aspen) and LCA tools (such as Umberto or GaBi). Almost half (47%) do not have access to such a link within their organisation, although half of those could see the benefit of having a link between their process simulator and LCA tools. The remaining 22% were unsure if they had a linkage or not.

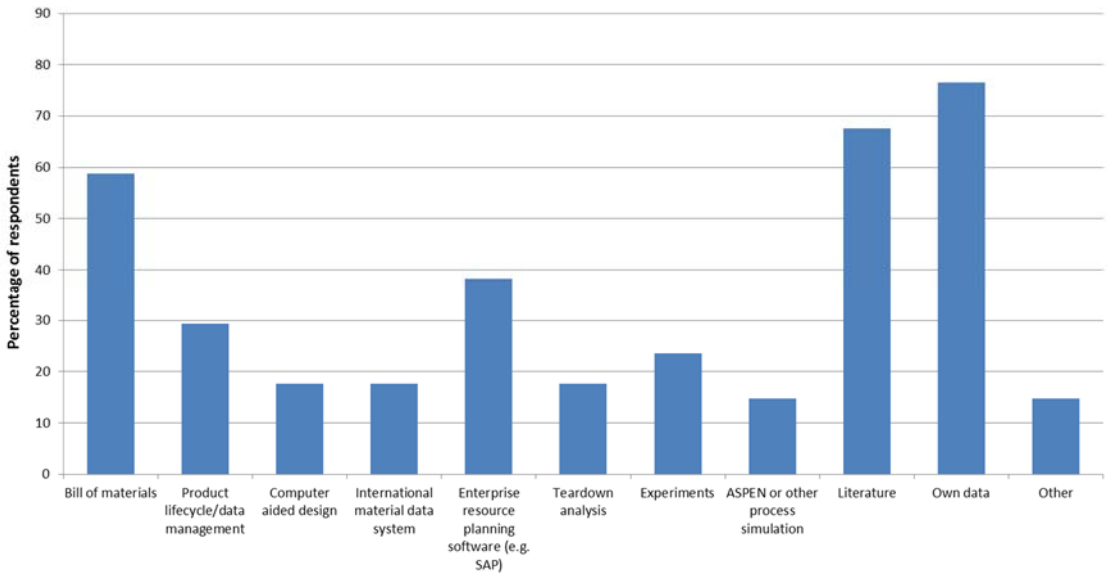


Figure 10. Data sources for material composition

4.3 Life cycle inventory data

Respondents were asked to select from a list of life cycle inventory databases those that they use. As shown in Figure 11, the most commonly used are the ecoinvent database (79% used it, of which 62% frequently) and industry association data (68% used, of which 50% frequently). ELCD (62% used, of which 29% frequently) and GaBi (56% used, of which 41% frequently) were also common data sources for the respondents. By contrast, Environmental input-output, ANL GREET and NREL US LCI databases were used much less frequently. The category “other” in Figure 11 relates to internal and supplier-derived inventory data as well as the Agri-footprint database.

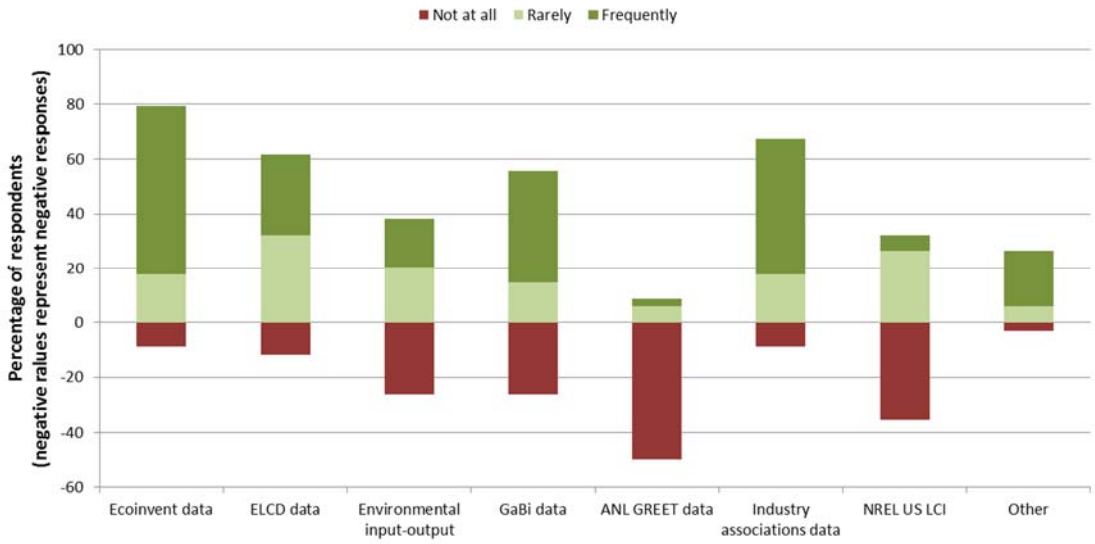


Figure 11. Use of life cycle inventory databases in LCA studies

Three quarters of respondents (76%) stated that their organisations were involved in the development of industry association LCA datasets, of which just 15% have only rarely been involved, with the remainder being actively involved within the industrial association or through their suppliers.

Respondents were asked to state if they explicitly assessed uncertainty of their data when undertaking LCA. Almost two thirds (62%) stated that they did, almost a quarter (21%) that they did not, although a third of those could see the benefit of doing so.

When faced with the question of how they would like to receive aggregated data from a supplier, more than half (55%) would prefer to receive the data directly from the supplier industry with the chance to have detailed discussions about how the data were calculated. Almost a fifth (18%) would prefer the data from a third party such as industry associations, database providers and 12% would prefer the data from a platform or database. Most of the 'other' category were also stating preference for direct data from the supplier but emphasising the need to know certain assumptions and descriptions of how data are calculated. One respondent stated that aggregated data are unacceptable.

Similar to the previous question, respondents were asked how they would prefer to receive aggregated data on how their waste or by-products were used by other industries. Almost half (48%) of respondents stated a preference to communicate directly with the other industry about how the waste/by-product was reused, recycled or disposed. One fifth (21%) stated that they would prefer to use aggregated data from industry associations or other third parties and 15% via a platform or database. Within the other category, some stated this was not an issue for their organisation/industry and one stated again that aggregated data are unacceptable.

With regard to the previous two questions, respondents were asked what they perceived as the main advantage of their chosen approach. Improved credibility was the most reported, stated by 82% of respondents. Just over half (52%) stated that their preference gave them good understanding about the modelling, 45% that it provided data relevant to their model, 39% that it would save them time to have data directly available, 36% that it provides comparability either internally or externally. Finally, 27% said that their preferred method gave them a direct contact person who they could approach for further information and 18% stated their preference due to avoiding additional costs.

Respondents were asked to state how important they saw the data quality and origin of external data when conducting an LCA. Responses were almost equally spread between “We usually use generic data from commercial databases” (37%), “We use generic data from databases for screening studies, but if we are working on a specific product, we try to use the specific data” (35%) and “We try to use specific data for the relevant flows being in close contact with our suppliers” (29%).

Finally regarding benchmarking, two thirds of respondents stated that they did compare the results of their studies with a benchmark product. Respondents did highlight the difficulty of benchmarking against an external product, relying on literature, estimations and extrapolations when necessary. Unsurprisingly, it was commented that it is easier if the benchmarking product is internal to the organisation carrying out the study.

5 Methodological choices

5.1 Environmental impact assessments

Respondents were asked to state at which level their organisation assessed the potential environmental impacts when conducting an LCA study. As can be seen in Figure 12, the midpoint level was the most popular, with 81% of respondents stating that they regularly used them and a further 13% using them sometimes. One third (32%) of respondents stated that they regularly used endpoint indicators whilst a further 32% used them sometimes; however, almost 30% never used endpoint indicators.

Just over a quarter of respondents (26%) stated that they used both midpoint and endpoint indicators regularly with slightly more (29%) using both sometimes. 10 percent stated that they would never use both. All the respondents that never use endpoint indicators use midpoint indicators regularly and similarly those that never use midpoint indicators use endpoint indicators regularly.

When respondents were asked the benefits of choosing either midpoint or endpoint levels, many respondents commented on the need for different data to be communicated at different levels (fellow researchers, management, public). In particular, endpoint indicators are easier to communicate to non LCA experts. In addition, the transparency of midpoint results, their ability to satisfy regulatory requirements, their scientific robustness, credibility and less uncertainty were highlighted.

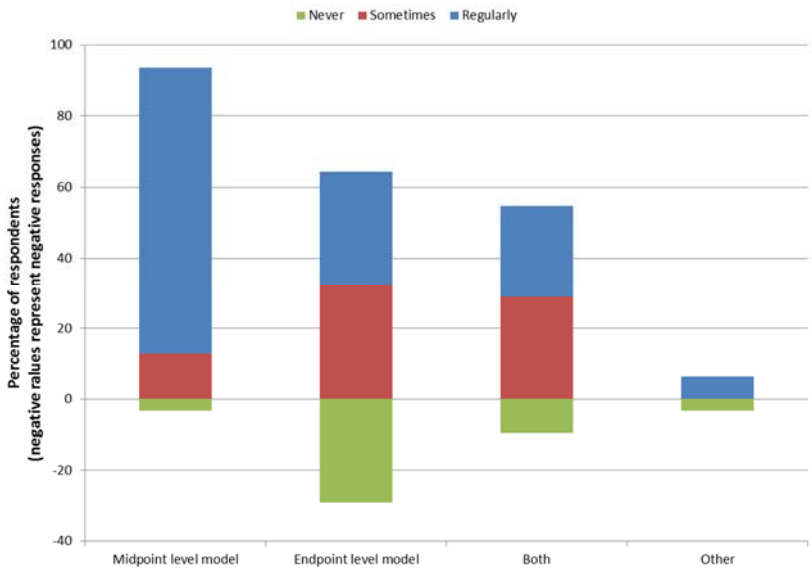


Figure 12. Assessment of potential environmental impacts

Respondents were asked to identify life cycle impact categories that were important for their organisation. The results are shown in Figure 13. Almost all respondents (97%) stated that climate change was important to their organisation, followed by acidification

(81%), eutrophication (72%), depletion of abiotic resources (63%) and land use change (59%). Human toxicity, photochemical oxidation, water availability, ecotoxicity and ozone layer depletion were each regarded as important by approximately half of respondents. Particulate matter (38%) and ionising radiation (22%) were reported as the least important of the listed impact categories. Others included primary energy demand and solid waste, although it should be stated that these could have proved more popular with respondents if explicitly included within the list presented in the questionnaire (as shown in the analysis in section 5.3).

Almost half (44%) of respondents agreed that their organisation was involved in improving the methodological shortcomings of the impact assessment methods shown in Figure 13. Just over a quarter (26%) disagreed and almost a third neither agreed nor disagreed. Impact assessment methods that respondents stated they were involved in improving included resource depletion/scarcity, eco- and human toxicity, land use change, water footprint/scarcity and non-renewable energy.

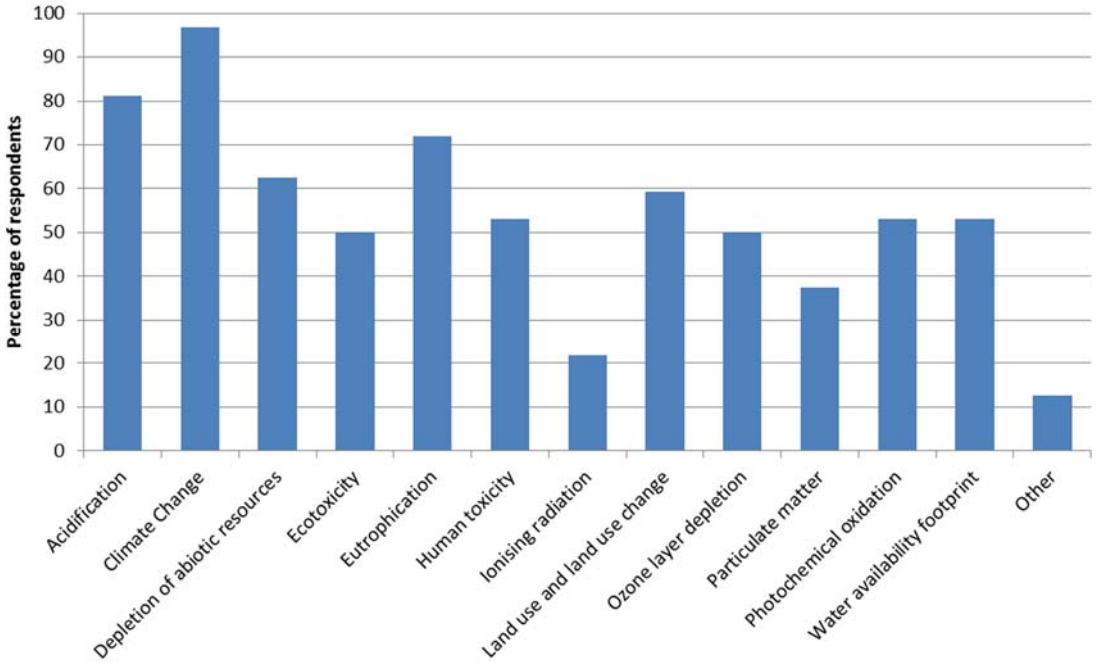


Figure 13. Important impact categories for organisations

5.2 Data interpretation

Figure 14 shows the responses when asked which optional steps with LCA their organisation performed by default. Normalization was most commonly performed with 50% of respondents undertaking normalisation by default for internal applications and 44% for external applications.

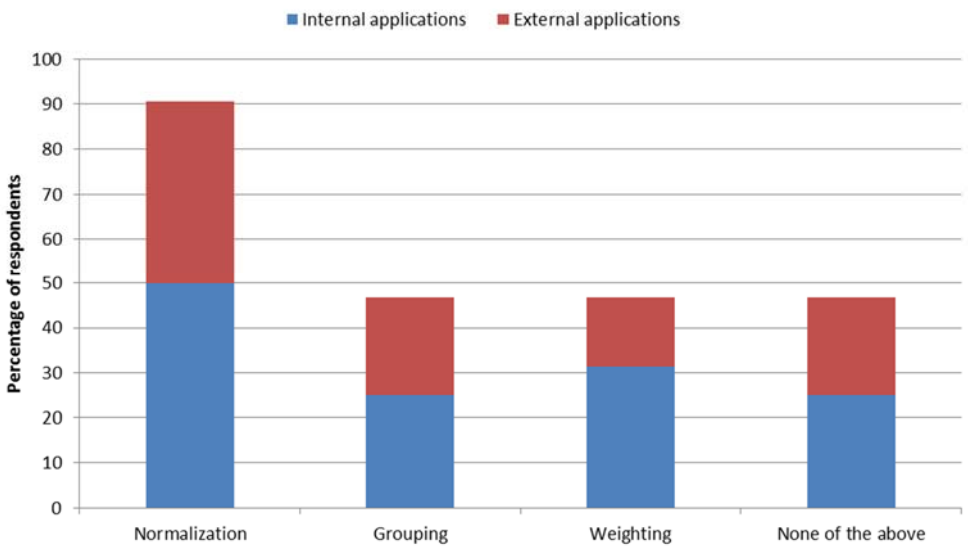


Figure 14. Optional steps of LCA performed by default

Grouping and weighting were used similarly, although for internal applications weighting (31%) was used more than grouping (25%). However, grouping was used more for external applications (25%) compared to weighting (16%). Approximately a quarter of respondents stated that they did not perform normalisation, grouping or weighting for either internal or external applications.

When asked how often sensitivity analysis was performed to assess the influence of key assumptions or parameters on the results, almost two thirds (61%) of respondents stated that this was done often. A further 15% stated that it was undertaken sometimes whilst 18% said it was rarely done and just 6% stated that sensitivity analysis was never undertaken.

Respondents were also asked how often they conducted uncertainty analysis to assess the influence of key assumptions or parameters. A fifth stated that they often undertook uncertainty analysis with a further 38% stating that this was done sometimes. Almost a third (31%) rarely undertook uncertainty analysis and 13% never.

5.3 Data reporting

Respondents were asked to select from a list of inventory categories those that they include in LCA reports and to state how often they use them. Whether the reporting was internal or external was not defined and the provided list was limited to:

- any toxicity parameter;
- primary energy demand;
- net water consumption;
- water use;
- waste to recover;
- waste to disposal; and
- other.

As can be seen in Figure 15, the most commonly reported is primary energy demand (60% often, 20% sometimes, 6% rarely), followed by net water consumption (38% often, 28% sometimes, 19% rarely) and water use (34% often, 25% sometimes, 22% rarely) with very similar results. Waste to disposal (25% often, 22% sometimes, 25% rarely) and waste to recovery (19% often, 25% sometimes, 25% rarely) were reported similarly whilst toxicity parameters were the least reported (19% often, 9% sometimes, 22% rarely).

It should be noted that there is some apparent inconsistency between this and the results presented in Figure 13 showing impact categories deemed important to the organisation. This could be for two reasons: first, the impact categories important to the organisation may be different from those that are reported, particularly externally. Secondly, whilst some respondents made use of the 'other' category, most, having selected from the list of responses presented, did not. Therefore, the different lists presented to the users in the two questions elicit different results.

Finally, respondents were asked how they would communicate LCA results within the context of high uncertainty due to, for example, allocation methodologies or database variation. The majority (39%) of respondents stated that they communicated uncertainty by providing a best and/or worst case scenario, with the same percentage stating that they communicated the full range of possibilities. Only 13% provided a single average value. Others stated that the preferred method of communication would depend on the context of the work being undertaken, sometimes agreed beforehand, while another response stated that they would use expert judgement to present the most likely scenario.

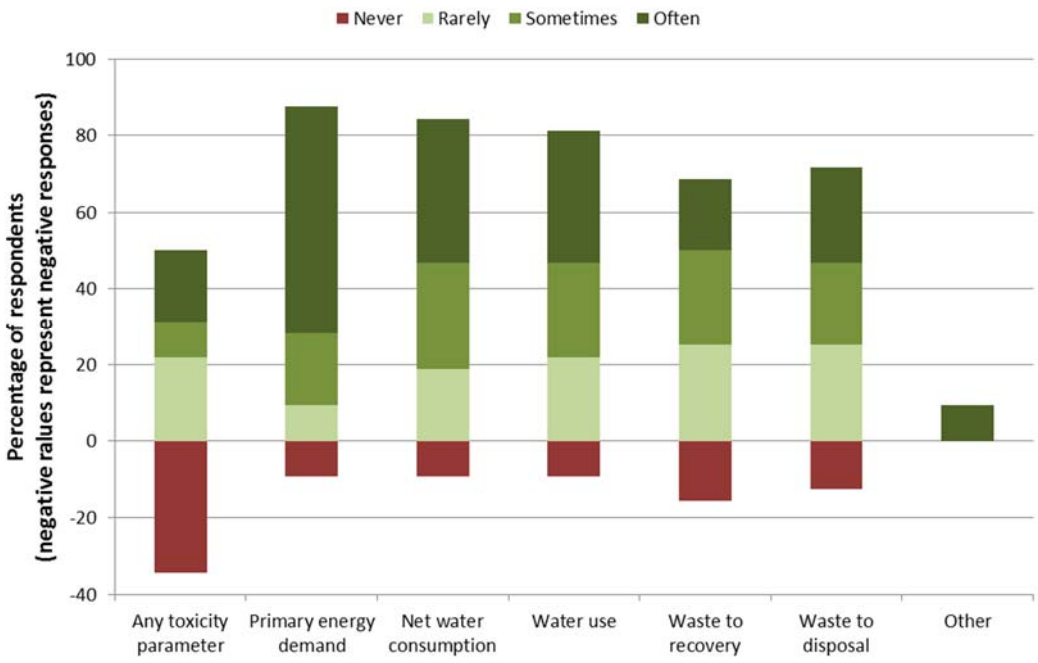


Figure 15. Reporting of inventory results

6 Current state of life cycle sustainability assessment and footprinting activities

In this section, respondents were asked a series of questions related to the application of life cycle sustainability assessment, social LCA and life cycle costing.

6.1 Life cycle sustainability assessment

Respondents were asked to define their main drivers for undertaking life cycle sustainability assessments (LCSA). As can be seen in Figure 16, by far the main drivers were to gain market advantage (62%) or exploit new business opportunities (52%). Regulatory issues within the sector (38%) and a core business improvement activity (33%) also scored highly. Those responding with 'other' stated they had no experience with LCSA.

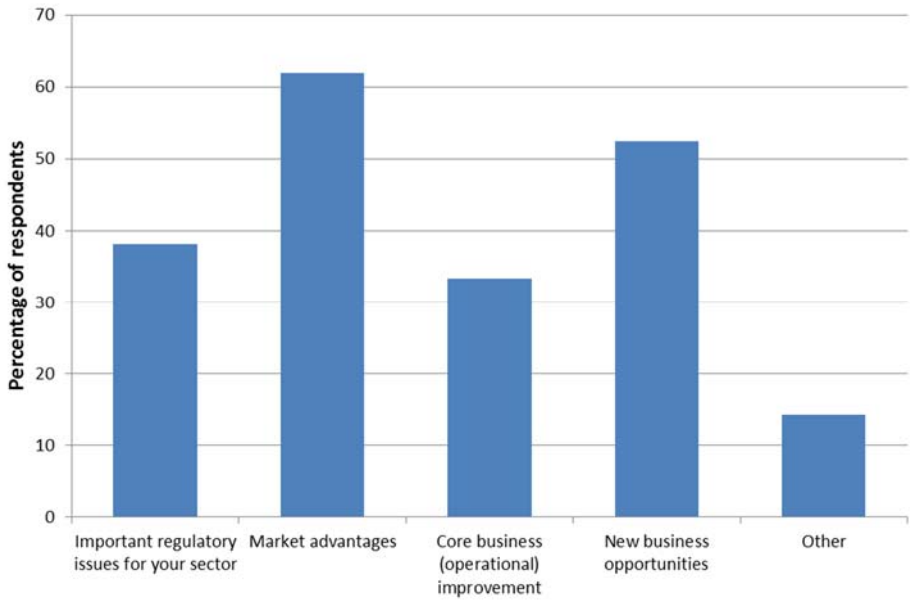


Figure 16. Main drivers to undertaking LCSA

Respondents were asked whether they considered the current development of LCSA complete with major impacts considered in estimating the potential impacts on the three pillars of sustainability for their product or service. No respondents stated that the current approach was complete, with 42% stating that there were significant gaps, in particular highlighting the social aspects; 57% of respondents stated that they did not believe the current development of LCSA was complete.

When asked about the weak points in the current state of sustainability assessment, data availability was highlighted by 79% of respondents, with 50% also highlighting data quality. The impact assessment methods (46%), management of uncertainty (43%) and a lack of understanding by stakeholders (43%) were also named as notable weaknesses.

6.2 Social life cycle assessment

In order to ascertain the extent of use of social LCA (SLCA), respondents were asked if they agreed or not with the statement: “You perform Social Life Cycle Assessment (SLCA) on the social aspects of sustainability in your organization at product level”. Just over a fifth (21%) of respondents either strongly agreed (7%) or agreed (14%) with this statement, suggesting that they performed SLCA on their organisation’s products. In contrast, 72% either disagreed (52%) or strongly disagreed (21%), whilst 7% neither agreed nor disagreed.

Respondents were asked to identify guidelines they considered when performing SLCA from a given list. The results in Figure 17 suggest that the global reporting initiative and UNEP/SETAC LCI guidelines for SLCA were the most popular, with almost two thirds (63%) of respondents considering them. Half of respondents considered the handbook for product social impact assessment and just under half (44%) the social hotspots database. SA8000 (31%), ISO 26000 (25%) and the UN Global compact (19%) were also utilised by respondents. No respondents considered the IChemE sustainability metrics. Those choosing ‘others’ had no experience with SLCA, although it could be seen by the lower number of responses overall that this by no means represented the total number of those not using SLCA.

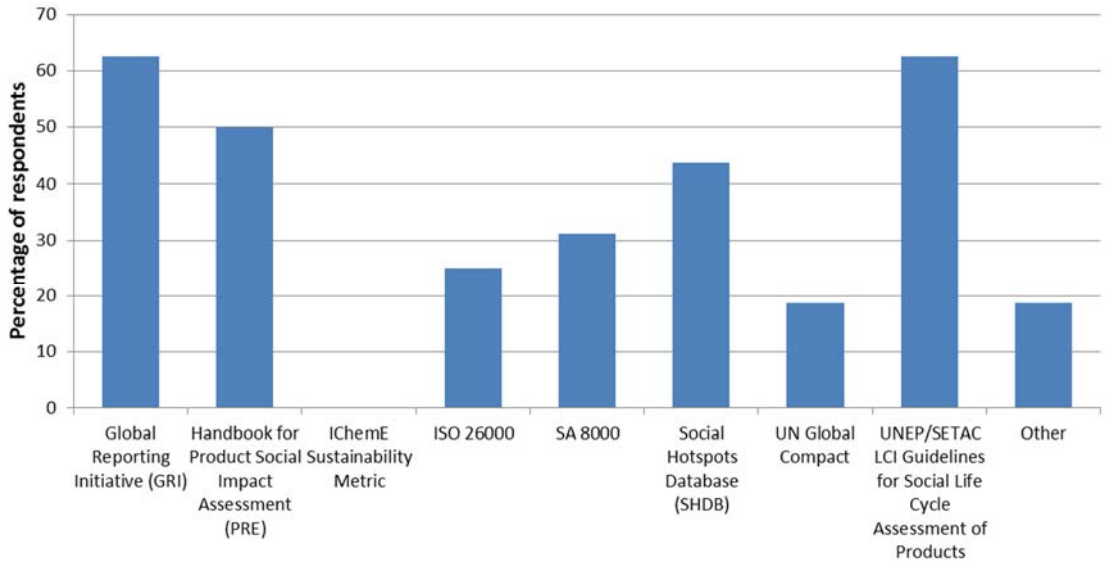


Figure 17. Guidelines used for SLCA

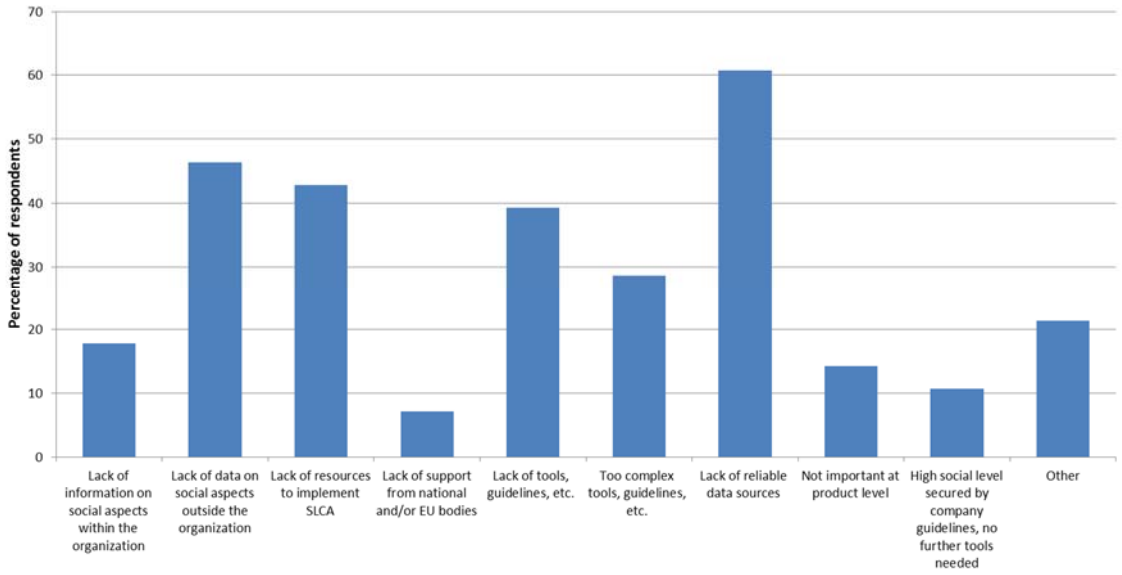


Figure 18. Barriers to performing SLCA

Respondents were also asked to identify from a list the main barriers to using SLCA in their organisation. From the results shown in Figure 18 it can be seen that lack of reliable data sources (61%), lack of data on social aspects outside of the organisation (46%), lack of resources to implement SLCA (43%) and lack of tools and guidelines (39%) were the most frequent barriers. Further barriers identified by respondents were the complexity of available tools (29%) and a lack of information on social aspects within the organisation (18%). Lack of support (7%), SLCA not being important at the product level (14%) and a high level of social assessment within existing company guidelines (11%) were identified as less significant barriers. Respondents choosing 'other' barriers included: a lack of demand for social LCA, a lack of experience within the organisation, a lack of metrics as well as lack of strategic guidance and objectives.

6.3 Life cycle cost analysis

Respondents were asked if they agreed with the statement "You perform life cycle cost (LCC) analysis on the economic aspects of sustainability in your organization including external societal costs in LCA results". The minority (16%) of respondents agreed whilst none strongly agreed. In contrast, 36% either disagreed or strongly agreed and 28% neither agreed nor disagreed.

Respondents were then asked if they agreed with the statement "You perform life cycle cost (LCC) analysis on the economic aspects of sustainability in your organization, only accounting for LCA costs to the user, but not accounting for externalities ". More than a third (36%) of respondents agreed, but still none strongly agreed; 29% disagreed with none strongly disagreeing and 36% neither agreed nor disagreed.

Respondents were also asked to choose from a list the advantages of using LCC that most applied in their organisation. Only a very small number of responses were obtained, as the question only applied to the small sample of respondents that were undertaking LCC. These responses showed a fairly equal split between evaluation and comparison of alternative products for customers; assessment of economic viability of projects or products for customers; optimization of product or service design by evaluation of alternatives; optimization of product or service design by performing trade-off studies for product suppliers; and evaluation of various operating and maintenance cost strategies to assist product users as well as product suppliers.

When asked to identify the main barriers to undertaking LCC within their organisation, the responses were similar to the barriers to SLCA, namely: lack of reliable data sources (43%), lack of data on internal and external costs (43%), lack of resources to implement LCC (39%) and lack of tools and guidelines (30%); see Figure 19. Over a quarter of respondents (22%) answered that the main barrier was that LCC was not a consideration for their company. A lack of support from EU and national bodies was not considered a barrier (4%) and neither was that existing tools were too complex (0%). Within the 'other' category, respondents stated that there was no driver to adopt LCC and hence no barrier, that LCC is not a sufficient measure within sustainability and that internal pressures to use existing economic metrics would prevent uptake of LCC.

When asked what actions would be needed to improve LCC adoption within their organisation just over half (52%) stated that more accurate data would be needed and 33% suggested each of the following:

- more resources needed within the organization to implement LCC;
- additional tools, guidelines, etc. supporting the implementation of LCC;
- mandatory normative framework on LCC; and
- specific trainings on LCC.

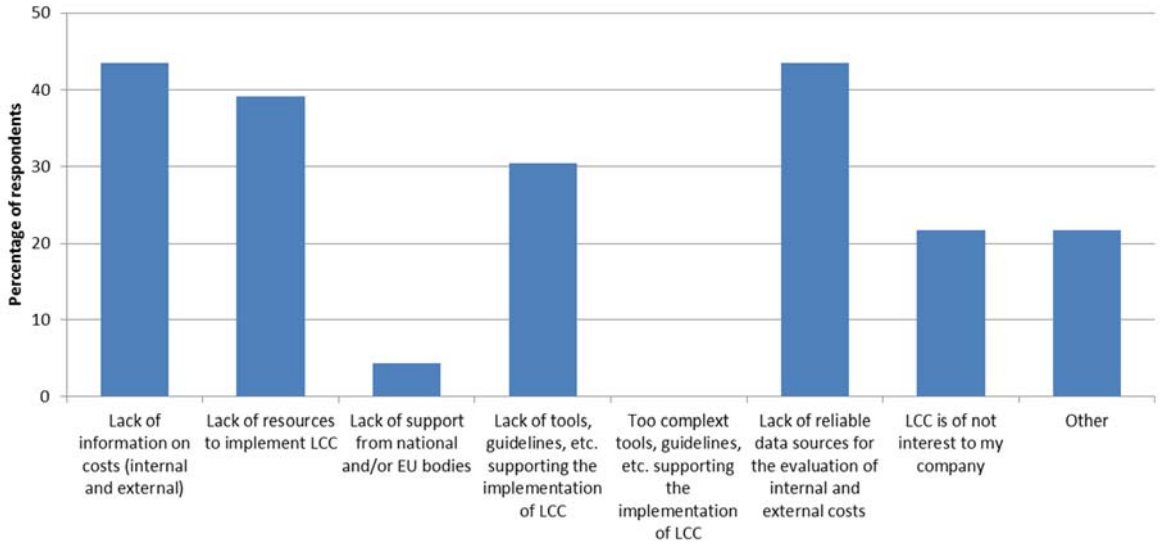


Figure 19. Barriers to performing LCC

Within the 'other' category one respondent again stated that overcoming the lack of a real driver for performing LCC was the main improvement needed.

6.4 Standardisation and PEF

Respondents were asked if they agreed that the standardization of any of the available LCA-based methods would be relevant for their organization (as for example ISO 14046 on the water footprint). Three quarters of respondents either agreed (30%) or strongly agreed (45%), whilst just 18% disagreed (15%) or strongly disagreed (3%).

Finally, respondents were asked how they considered the current development of the EU's PEF initiative with results shown in Figure 20. The most popular response, from over a third (36%) of respondents, was that the PEF initiative is heading in the right direction but that substantial improvements were needed. Whilst no respondents stated that their organisation was not interested in PEF, 15% stated that they had no opinion on PEF and 12% felt that PEF introduced more confusion than harmonisation. Only a few (9%) felt that PEF was heading in the right direction in its current state and even fewer (6%) felt that it would make a good complement to ISO 14040/14044.

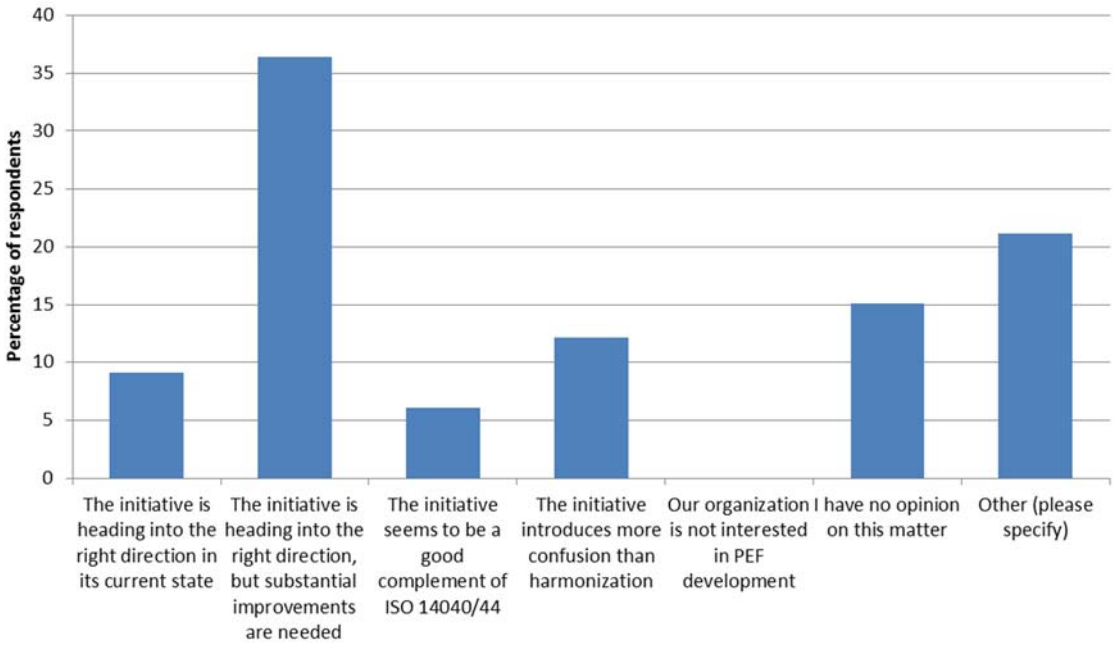


Figure 20. Respondents' opinion on the EU's PEF initiative

Respondents made a number of further comments, including:

- "PEF initiative is regarded critically in our organization due to increasing demand of data availability".
- "The initial intention of comparability seems to have been lost during the project so that it appears many developed PCR's leave little room for innovation or differentiation."

- “It is a very challenging initiative with a lot of shortcomings, but overall a positive contribution.”
- “Lack of clarity of the intention: another guideline reference or a real path towards labelling and regulations based on the quantified environmental performance of products?”
- “It is a good initiative. It needs time to mature and it should not be used before it is ready. Better to use other EPD-systems until it is ready.”

7 From research and development to full scale using the right tools

7.1 New product and process design and development

Respondents were first asked whether they used life cycle based analyses for decision making during the product design phase. Over a third (39%) stated that they did use such analyses regularly (over 10% of new developments) and a similar number (36%) answered that they did so sometimes (less than 10% of new developments). Almost a quarter (24%) said that they did not perform life cycle-based analyses for decision making during a product design phase.

Respondents were asked if they agreed with the statement “You compare the potential environmental impact related to alternative raw materials, choice of technologies, etc during the product design phase”. Over three quarters (88%) of respondents either agreed (68%) or strongly agreed (20%). Just 4% disagreed with the remaining 8% neither agreeing nor disagreeing.

Respondents were asked if their organization used life cycle based analyses for decision making during the development of a novel production process. The majority (39%) of respondents stated that they did so regularly (more than 10% of new developments), 29% stated that they did so sometimes (less than 10% of new developments) and 32% stated that they did not.

7.2 Temporal LCA

Respondents were asked if they agreed with the statement that they used technology development scenarios to obtain forecasts of future environmental and economic impacts of technology (temporal LCA). Just over a third stated that they either agreed (29%) or strongly agreed (6%) whilst almost half (42%) either disagreed (32%) or strongly disagreed (10%). Almost a quarter (23%) neither agreed nor disagreed with the statement.

In follow up to the previous question, respondents using scenarios were asked how they developed those scenarios. Whilst there were only a few responses, over half (56%) stated that they used arbitrary estimates of targets of future performance to develop scenarios. Over a third (38%) stated that they used process models such as ASPEN. Other methods for developing scenarios included using energy models, relevant policy goals, scenarios provided by independent organisations or from strategic goals of institutions.

7.3 EU Horizon 2020

Respondents were asked to state the importance they put on the criteria provided by the Horizon 2020 program that demands the evaluation and reduction of fossil energy inten-

sity, primary raw material intensity and greenhouse gas emissions by funded SPIRE projects. Half of respondents stated that they saw the criteria as being of high importance, with a further 28% of medium importance. The remaining respondents stated that they saw the criteria as being a low priority (9%) or of no importance at all (13%).

As a follow up question, respondents were asked to state whether they agreed or disagreed with the statement that the criteria mentioned above were sufficient to quantify the future environmental impacts of the newly developed product or process. There was a fairly equal split between respondents, overall agreeing or disagreeing with the statement. Whilst only 3% strongly agreed with the statement, 33% agreed. Meanwhile, 3% strongly disagreed whilst 36% disagreed. Almost a quarter (24%) neither agreed nor disagreed. When asked what further criteria may need to be considered in addition, responses included water footprint and other environmental categories, waste, land use, ecotoxicity, human health, eutrophication, acidification, economic/financial criteria, particles, local direct emissions and social impacts.

Finally, continuing to discuss SPIRE and the Horizon2020 program, respondents were asked if they agreed or disagreed with the statement that the design and assessment approach followed in those European projects can be valuable also for their company internal innovation management. Almost two thirds (65%) of respondents agreed with this statement, with a further 3% strongly agreeing. Only a small minority (3%) of respondents strongly disagreed and no respondents disagreed. Almost a third of respondents (29%) neither agreed nor disagreed.

1.1 Decision making with life cycle sustainability assessment

Respondents were asked if they applied multi-criteria decision analysis (MCDA) to their LCSA results. The results in Figure 21 show that the majority of respondents (58%) never or rarely carried out MCDA stating that providing the impact values was sufficient. A further 19% of respondents also did not use MCDA but could see the benefit of doing so. Only 13% used MCDA, 3% regularly and 10% occasionally. One respondent stated that they utilised MCDA but not as a strict mathematical process and another, perhaps confusingly, that “MCDA would not lead to a single score” (It is not clear if the respondent meant that the single score produced would not be desirable or usable or that it would not be able to produce an accurate representation in one value).

Two further questions specifically targeted to those who applied MCDA to their LCSA results were not answered by enough respondents to be of interest statistically.

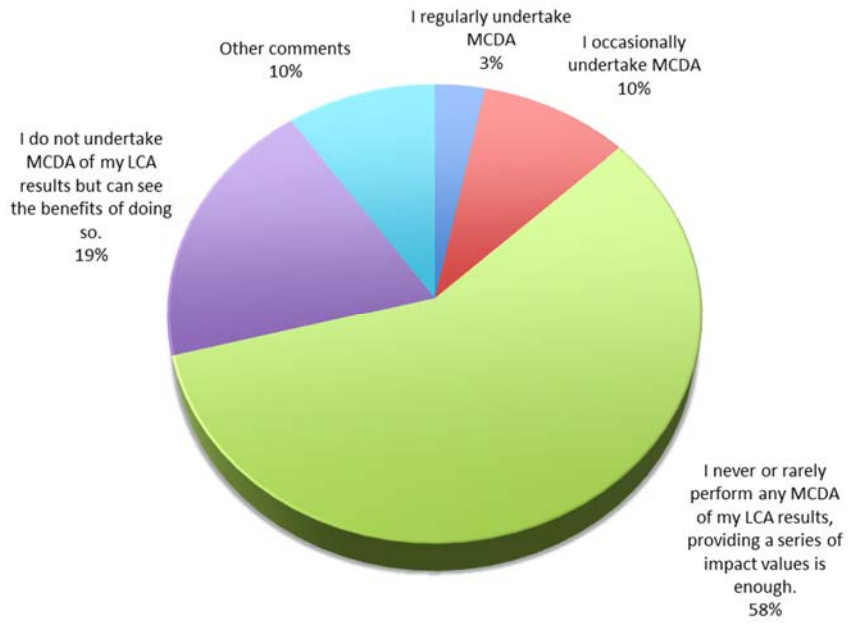


Figure 21. Application of MCDA with LCSA results

8 Conclusions

The MEASURE survey was successful at sampling individuals working within a number of European process sectors, across a range of European countries and within a variety of different business types (e.g., manufacturing, industrial research, consultancy and academia).

The responses obtained from the survey suggest that LCA remains an important factor within the European process sector, with over half performing LCA on over 30% of their turnover coverage. Almost all respondents undertake LCA following the ISO14040/44 standard, supported by a range of additional LCA frameworks.

Whilst LCA is used in many applications in the European process sector, the main focus is product development and innovation as well as marketing and customer demand. LCA studies are undertaken using a range of data sources although literature remains the most common and, although a number of inventory databases are used, ecoinvent and industry associations are the most relied upon. Midpoint LCA impacts are used by almost all respondents, but over half also use a mixture of both midpoint and endpoint categories. Climate change remains the most important impact category to respondents but a range of impacts are used with water and energy impact being regularly mentioned. Whilst respondents are making use of LCSA, SLCA and LCC, the main barriers to doing so remain a lack of reliable data sources/databases as well as a lack of information internally and externally (either upstream or downstream) on social aspects or costs. A lack of resources to undertake SLCA or LCC is also significant.