



HM Government

Unlocking Resource Efficiency

Phase 1 Technical Summary

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1. Introduction

The Department for Energy Security and Net Zero commissioned a research project to explore the potential benefits from increasing resource efficiency across UK industry. This research was carried out in collaboration with The Department for Environment, Food & Rural Affairs.

This report sets out the methodology used in this research project.

The results of this research are presented in the accompanying executive summary, and sector-specific reports.

2. Methodology

2.1 Overview

The first stage of this research was to conduct a comprehensive literature review to gather the latest evidence on the research objectives. The findings from this literature review were then presented at two half-day facilitated workshops with a range of sector experts from both academia and industry. The purpose of these workshops was to test the findings of the literature review against stakeholder expertise, and to fill any evidence gaps from the literature.

The methodology has been split into five tasks as outlined in Table 1.

Table 1: Description of the tasks

Task	Name	Description
Task 1	Measures and indicators	Development of a preliminary list of resource efficiency measures and indicators that fed in to the following tasks.
Task 2	Literature review	Delivery of a rapid evidence assessment looking at academic, government and industry sources to identify information on the research objectives. A summary of these findings was sent to workshop participants ahead of the workshops.
Task 3	Workshop planning	Preparation for the facilitated workshops. This includes stakeholder selection, stakeholder engagement and development of the pre-workshop survey.
Task 4	Workshop delivery	Two facilitated half-day workshops held for each sector.
Task 5	Reporting	Summarising the results from Tasks 1 – 4 into the executive summary and the sector specific reports.

2.2 Task 1 – Measures and Indicators

A preliminary list of measures and indicators was drawn up based on the expertise of the research team for each sector. This helped prepare for the rest of the tasks (e.g., identify search terms for Task 2, literature review) without pre-empting the results.

The final list of measures and indicators was drawn up based on the literature review and the stakeholder engagement.

2.3 Task 2 – Literature Review

2.3.1 Identifying literature sources

To ensure that the literature review was as comprehensive as possible, three different strategies were used to identify relevant literature:

- The research team and the Department for Energy Security and Net Zero/Defra provided relevant sources;
- Expert stakeholders provided relevant sources; and
- An online search was used to identify additional relevant sources.

For the online search a list of search strings relating to resource efficiency and the circular economy was collated for each sector. These search strings were informed by the research teams sector experts and included a range of both generic and sector specific phrases. These phrases were combined with Boolean operators (“AND”, “OR”, and “NOT”) to narrow or broaden the set of results.¹

For example, some search strings used in the steel sector were ““steel resource efficiency”, “steel AND waste minimisation”, “proportion of coke used in UK steelmaking”. A full list of all the search strings used can be found in the annexes of the sector specific reports.

Subsequently, the collated search strings were used in online search engines including Google, Google Scholar, and Scopus to identify individual research papers as well as grey literature. Scientific, governmental and industry reports and articles found in authoritative databases (mainly Science Direct, Research Gate and Springer) were prioritised.

2.3.2 Assessing the literature sources

Once the literature sources had been identified, an indicative applicability score (IAS) was calculated for each source to reflect the applicability of the source to the scope of this research.

¹ An example of this involves the use of the expression “steel AND circular economy”, in which case the search engine targets results that combine the word ‘steel’ with the phrase ‘circular economy’. Another example would be the choice of the term “steel recycl*” whereby the asterisk allows for the search to be broadened by accounting for the different variations of words starting with “recycl-“ (i.e. the search engine would show results involving the words recycling, recycle, recycled, etc.).

This score was based on five key criteria: geography, date of publication, sector applicability, methodologies used and level of peer review. Each of these criteria were scored at one of three levels as outlined in Table 2.

Table 2: Five criteria of IAS and scoring criteria

Criteria	High	Medium	Low
Sector relevance	The source is specific to the sector, and to the measure. It discusses resource efficiency and circularity.	The source is specific to the sector.	The source discusses several sectors.
Geographic relevance	The source is based on UK data / UK experience.	The source is not based on UK data / UK experience but it is applicable (e.g., because a similar technology is used in the UK).	The source is not based on UK data / UK experience and it is not applicable.
Time relevance	Less than 10 years old.	Between 10 and 20 years old.	More than 20 years old.
Peer review	The source has been peer reviewed (e.g., published in an academic journal).	The source does not mention it, but it is assumed to have been peer reviewed.	There is no evidence of peer-review.
Methodology	The research methodology is well defined and it is deemed appropriate.	The research methodology well defined but it is not deemed appropriate / Minor description of research methodology.	No research methodology included.

After the five criteria of the IAS have been evaluated, the overall IAS score is calculated, ranging from 1 to 5, according to the number of components scoring 'high' and 'low'.

Table 3: Methodology for the calculation of the IAS

Number of 'high' criteria	Number of 'low' criteria	IAS
Indifferent	3 or more	1
<= 1	2	2
>= 2	2	3
<= 2	1	3
>= 3	1	4
<= 1	None	3
2	None	4
>= 3	None	5

A full list of all the literature reviewed, and their IAS can be found in the accompanying sector reports.

2.3.3 Summarising the literature sources

Once the literature review was completed, the preliminary list of measures and indicators prepared under Task 1 was amended with the literature findings.

The information from the literature review was then summarised into sector reports, which presented the literature findings for each measure against each of the four research objectives. Where there was diverging information from the literature sources, preference was given to the sources with highest IAS, as these were deemed most reliable and most relevant to the research scope.

2.4 Task 3 – Workshop planning

2.4.1 Stakeholder selection

The first stage of Task 3 was to identify expert stakeholders to invite to the facilitated workshops. The stakeholder selection process was informed by the following criteria:

- Ensuring representation of industry actors from across the value chain;
- Ensuring representation from the research and academic fields;
- A maximum of 25 participants per sector, to ensure the workshops allowed enough space for contributions from all stakeholders; and
- Availability to participate in the two workshops.

2.4.2 Stakeholder engagement

Stakeholders were contacted via email with the request to participate in the research for the selected sectors. An invitation letter was attached which explained the motivation, objectives, and purpose of the research, and which was signed by representatives of the Department for Energy Security and Net Zero and Defra.

2.4.3 Pre-workshop survey

Ahead of the workshops a summary of the literature review (see Section 2.3.3) was shared with all workshop participants. A pre-workshop survey was shared alongside the literature summary to allow participants to share any feedback ahead of the workshop session. The literature summary and pre-workshop survey were also shared with some participants who were unable to attend one or both facilitated workshops to ensure their expertise could still be captured.

The pre-workshops survey asked participants to comment on the list of resource efficiency measures, their drivers and barriers, and estimates of their current, maximum and BAU levels of efficiency (and proposed indicators) that had been identified in the literature review. It also invited participants to share additional literature they were aware of with the research team.

Where additional literature was provided by stakeholders it was evaluated against the IAS framework described above and used to inform the final research conclusions.

2.5 Task 4 – Workshop delivery

Two facilitated workshops were held for each sector, with a duration between three and three and a half hours each. The workshops were held online via MS Teams and all stakeholders were invited to both workshops.

The purpose of these workshops was to test the findings from the literature review with stakeholders, to allow stakeholders to share their expert views on the research objectives, and to fill any gaps which had been found in the literature.

2.5.1 Workshop 1

The first workshop focused on the first and third research objectives:

- 1) Identify a comprehensive list of resource efficiency measures.
- 3) Build consensus estimates for the current “level of efficiency” and maximum “level of efficiency” in 2035, for each of the identified resource efficiency measures.

Where the stakeholders showed a majority disagreement with the definition of any resource efficiency measure, or with the indicator chosen to measure the levels of efficiency, these were reviewed by the project team and adjusted before the second workshop.

2.5.2 Workshop 2

The second workshop focused on the second and fourth research objectives:

- 2) Identify current and anticipated drivers and barriers which are affecting improvements in the identified resource efficiency measures, and their relative importance.
- 4) Identify the extent to which industry is currently improving resource efficiency and build consensus estimates for the likely “levels of efficiency” in 2035 given current private sector incentives and the existing policy mix (a “business-as-usual” scenario), for each of the identified resource efficiency measures.

In the workshops the workshop lead (who was a sector expert) gave a short overview of each measure and the information that had been found in the literature review. Participants were then asked to share their initial thoughts on the relevant research objectives via an online whiteboard. This was then followed by an open discussion, facilitated by the sector lead, to draw out key insights, areas of consensus and areas of disagreement.

After the discussion, participants were asked to vote on most the significant drivers and barriers for the measure, and the estimates for the levels of efficiency. The voting was used to gather a snapshot of stakeholder views and the level of consensus. The results of the votes were used alongside the information from the online whiteboard, and comments made via the chat and in the discussion to inform the research conclusions.

There were a total of 56 workshop participants in Phase 1, ranging from 11 to 22 participants per sector.

2.6 Task 5 – Reporting

Information gathered in the workshops was used, alongside information from the literature, to inform the conclusions in the final reports.

The one exception to this is for the estimates of the BAU levels of efficiency (research objective 4), where there was generally no information available in the literature. In this case the conclusions have been solely informed by information from the stakeholder engagement (via the facilitated workshops and pre-workshop survey).

2.6.1 Levels of efficiency

The estimates for the current, maximum and BAU levels of efficiency for each measure are presented in the accompanying sector specific report, alongside a summary of the evidence that underpins these estimates.

For each level of efficiency, an evidence RAG rating has also been provided which reflects the strength of the evidence supporting the conclusions.

- **Red:** Limited evidence available from literature review or stakeholders
- **Red-amber:** Some evidence available from literature review but it is not relevant/out of date, limited evidence from stakeholders, stakeholders are not experts on this measure
- **Amber:** High quality evidence from either literature or stakeholders
- **Amber-green:** High quality evidence from literature or stakeholders, evidence from stakeholders is supported by some information in the literature (or vice versa)
- **Green:** High quality evidence from literature supported by stakeholder expertise.

Note, because the estimates for the BAU level of efficiency were only based on stakeholder input the maximum evidence RAG rating they received was amber.

2.6.2 Drivers & Barriers

The identified drivers and barriers for each measure are described in the sector-specific reports, alongside examples or caveats provided by either the literature sources or stakeholders. The PESTLE and COM-B categories have been assigned to each driver and barrier.

Drivers and barriers were categorised using two separate systems:

1. The PESTLE framework which is focused on the types of changes: political, economic, social, technological, legal and environmental;
2. The COM-B framework which is focused on behaviour change:
 - **Capability:** can this behaviour be accomplished in practice?
 - Physical Capability – e.g., measure may not be compatible for certain processes
 - Psychological Capability – e.g., lack of knowledge

- **Opportunity**: is there sufficient opportunity for the behaviour to occur?
 - Physical Opportunity: e.g., bad timing, lack of capital
 - Social Opportunity: e.g., not the norm amongst the competition
- **Motivation**: is there sufficient motivation for the behaviour to occur?
 - Reflective motivation: e.g., inability to understand the costs and benefits,
 - Automatic motivation: e.g., lack of interest from customers, greater priorities

During the workshops, stakeholders were asked to vote on the most significant drivers and barriers for each measure, and these are presented in bold in the summary tables in the sector-specific reports.

2.6.3 Final Report

The findings of Phase 1 have been summarised into 6 reports:

- The technical summary;
- The executive summary which provides an overview of the research purpose, research objectives and high-level information about the key research conclusions both by sector, and across all sectors;
- Four sector-specific reports which provide detailed information on the research conclusions for all four research objectives and for each resource efficiency measure. This includes estimates of the current, maximum and BAU level of efficiency for each measure.

2.7 Limitations

This report was commissioned by the Government to improve the evidence base on the impact of resource efficiency measures. The methodology is designed to provide robust answers to the research objectives, based on the best available evidence at the time the work was undertaken.

While every effort was made to be comprehensive in the literature review, it is inevitable that some relevant literature may not have been captured. A full list of all the literature reviewed is provided in annexes of each sector report.

The feedback captured during the workshops represents the views of a sample of stakeholders from industry, think tanks, trade associations and academia. Effort was made to ensure that the workshops included a cross-section of stakeholders from each stage of the sectors' supply chain, representing a range of backgrounds and perspectives. It is, however, noted that capacity and scheduling limitations meant that some stakeholders, whose view would have been valuable to the research, were not able to participate. This was mitigated with a pre-workshop survey that was sent to a wide range of stakeholders, including some who did not attend the workshop.

A key research objective of this project is to estimate the level of efficiency of resource efficiency measures in 2035. Any future projections are inherently uncertain as they depend on a range of different factors such as technological innovation, consumer behaviour change and

the macro-economic environment. The estimates from this research are the best estimates that could be produced, based on the current literature and stakeholder expertise. Evidence RAG ratings have been provided to indicate the level of supporting evidence for each of these estimates.

The report does not seek to make recommendations on the appropriate direction of government policy or independent industry action. The Department for Energy Security and Net Zero and Defra will seek to conduct further engagement with stakeholders to inform the next steps for resource efficiency policy within government, ensuring that any omissions or developments in the evidence reviewed in this report are taken into account.

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