**Investigation into the efficiency of current municipal waste incineration facilities in England to destroy Persistent Organic Pollutants (POPs)**

**Aim:**

This research project aims to establish the POP destruction efficiency of municipal waste incinerators. This is relevant given Defra’s current position, based on the Basel Convention technical guidelines[[1]](#footnote-2), that municipal waste incinerators (MWIs) are an appropriate disposal route for waste containing brominated flame retardants (BFRs), and that there are no significant adverse impacts on the environment from this disposal route (either via emissions to air or the residues produced).

**Background:**

The UK is a signatory of the UN Stockholm Convention for Persistent Organic Pollutants (POPs)[[2]](#footnote-3) and has regulations in place to meet our obligations under the Convention. The EU Regulation 2019/1021 applies directly in Northern Ireland and has been retained in Great Britain as amended by the POPs Regulations 2020[[3]](#footnote-4).The Stockholm Convention controls and restricts the global production, use and emissions of substances listed under the Convention as POPs. It also requires that all parties destroy or irreversibly transform all waste containing POPs present above specified thresholds. New POPs are continually being added to the Convention, and very often these substances have been used for many years prior to their restriction coming into force. Depending on the use of these substances it can mean that they are present in consumer items and these items are not easily identifiable as containing POPs. Consequently, identification of contaminated items when they become waste is extremely difficult, meaning the destruction of whole items and/or all items of a certain type. Consequently, this can lead to increased volume of waste needing to be incinerated (the most widely available destruction technique for some POPs) as opposed to being sent to landfill.

A group of substances known as brominated flame retardants (BFR) have been widely used, several substances from this group have been listed as POPs. They have been used for years as flame retardants in consumer items including electrical equipment and soft furnishings. The POP-BFRs of particular interest include the polybrominated diphenyl ethers (PDBEs), octabromodiphenyl ether (octaBDE), pentabromodiphenyl ether (pentaBDE) and decabromodiphenyl ether (decaBDE) and hexabromocyclododecane (HBCDD).

Recently, there has been studies including sampling of waste undertaken to determine POP-BFRs in two major waste streams, waste electrical and electronic equipment (WEEE) and waste domestic seating. The group of known as Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS). PFAS, are known to have wide uses, and are found widely in the environment. Two PFAS are listed on the Stockholm Convention as POPs (PFOS and PFOA), and PFHxS has been listed recently, due to be enforced by the Convention in late 2023. PFAS are known to be resistant to thermal degradation, unless under conditions of high temperature incineration, but due to their wide usage over the years they are likely to be present in wastes treated by MWI.

In the UK the Industry Council for Electronic Equipment Recycling (ICER), in cooperation with Defra and EA, published a report in 2020 on an investigation into the presence of chemicals used as flame retardants in more than 2000 items of WEEE. The analysis confirmed that there are often high levels of hazardous chemicals, including PBDEs, in many items of WEEE. DecaBDE was found to be present in many types of WEEE including small mixed WEEE, display devices and refrigerators[[4]](#footnote-5).

In 2020, Defra funded desk-based study on POPs in soft furnishings aimed to provide data that would allow the identification of articles likely to be contaminated with these substances. The report looked at where materials currently go at end of life and how are they treated and disposed of. The report concluded that decaBDE and HBCDD were used in the back coatings of textile coverings for a range of soft furniture applications. Where this is the case the textile coverings for sofas are likely to have the highest concentrations, with foam and fibre cushioned seating acting as a sink for the decaBDE/ HBCDD, which has leached from the textile covering. The research concluded that domestic seating (such as sofas) should be a priority area for working with the waste handling industry to investigate current waste handling practices and identifying appropriate actions required to ensure that the POPs in waste items are dealt with correctly[[5]](#footnote-6) .

In 2021, a waste domestic seating sampling study was commissioned by the Environment Agency. Approximately 1000 samples from 300 items were screened for the presence of bromine, an indicator of the potential presence of a brominated flame retardant, to provide an understanding of their occurrence in the waste stream. A selection of high bromine samples were then sent for laboratory analysis to identify what proportion of these contained POPs. Results indicated that 44% of items with fabric covers and 12% of items with synthetic leather covers are affected but only a very small proportion of leather covers are potentially affected[[6]](#footnote-7).

Different POPs are destroyed at different incineration temperatures1, 9 to meet our obligations to the Stockholm Convention, POPs waste and POPs in waste above the waste limit must be destroyed or irreversibly transformed. To determine destruction, destruction efficiency1,8, [[7]](#footnote-8) for POPs needs to measured or estimated. The Basel Convention guidance1 states that PBDEs can be destroyed in Municipal Waste Incinerators (MWIs) which[[8]](#footnote-9), in the UK, are required to operate at 850oC or above. We recognise that this guidance is based on a limited number of studies and that further work to consider the performance of UK facilities would be valuable. We consider that MWIs are the most appropriate disposal route for waste containing BFRs and there is currently no evidence to the contrary. A Defra Evidence Statement highlighted the need for more data on the emissions of POPs from thermal destruction processes using complex, heterogenous waste streams[[9]](#footnote-10). This work will build on the evidence detailed in this Evidence Statement and is to provide further evidence that can be used evaluate Defra’s current position.

In the UK it is understood that items of soft furnishings are likely to contain a higher concentration of flame retardants compared to that of other countries, for example across Europe. This is because the UK has more stringent Furniture and Furnishings (Fire Safety) Regulations. Therefore, this project will provide a valuable perspective given the relatively unique UK waste mix.

**Overarching objectives:**

The objectives of this project are to:

1. Monitor the emissions to air of polybrominated dibenzo p-dioxins and polybrominated dibenzofurans (PBDD/F) from three MWIs which are actively taking either domestic seating waste and/or brominated Waste Electrical and Electronic Equipment (WEEE) plastics from density separation plants (often in Solid Recovered Fuel (SRF) or Refuse Derived Fuel (RDF)) at the time of monitoring and three MWIs not actively taking either of these waste streams. Using the established methods of sampling for chlorinated dioxins as a guide and to inform the number of samples to take per site to be sufficiently representative.
2. Sample and analyse the bottom ash and Air Pollution Control (APC) residue of these incinerators for PBDD/F, total bromine and residual BFRs (including but not restricted to POP (Persistent Organic Pollutant) BFRs found in waste domestic seating and WEEE). In addition to these brominated substances, analysis on POP Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS), namely Perfluorooctane sulfonic acid (PFOS), Perfluorooctanoic acid (PFOA) and Perfluorohexane sulfonic acid (PFHxS) is also requested. There is relevant guidance available on sampling methodology such as the Environmental Services Association (ESA) sampling and testing protocol to assess the status of incinerator bottom ash (IBA)[[10]](#footnote-11) as well as the Guidance on the classification and assessment of waste (WM3)[[11]](#footnote-12). Guidance such as this should be referred to ensure the number of samples taken per site are sufficiently representative. Obtain and include any existing information available from the operator relating to these chemicals in IBA, APC residue and emissions.
3. Estimate the total quantities of PBDD/F, total bromine and residual BFRs (including but not restricted to POP BFRs) within bottom ash and APC residue results, PBDD/F in stack emissions.
4. Estimate the Destruction Efficiency for POP BFRs for each of the three MWIs that are actively taking brominated wastes.
5. Analyse and report the results and state conclusions in respect of the environmental impact of this disposal route, including comparison to results reported in relevant academic literature and relevant reports.

**Project Outcomes**:

The project will determine levels of brominated dioxins and furans in the emissions to air and levels of brominated dioxins and furans, bromine, and residual BFRs in the residues (bottom ash and Air Pollution Control (APC) residues) from MWIs which are actively taking either domestic seating waste and/or brominated WEEE plastics from density separation plants at the time of monitoring. These levels will be compared with those levels from MWIs not actively taking either of these waste streams. Once sampled and analysed the levels will be detailed within a report. Destruction efficiency will be determined.

In addition to these brominated substances, analysis on POP PFAS, namely PFOS, PFOA and PFHxS is also requested. The analysis of these POP PFAS is required to assess whether the current and any future POP waste limits for these substances are being met within this waste stream. Therefore, results will be compared to the current and proposed waste limits.

The analysed results within the report will supply Defra with data derived from sites in England but should provide UK relevant evidence on the efficiency of MWIs at destroying brominated flame retardants. It will provide evidence on the current efficiency and potential future efficiencies if the quantity of waste containing brominated flame retardants being sent to MWI increases. Therefore, the project methodology should be designed to include consideration of the highest feasible BFR input, i.e., a reasonable worst- case scenario.

This project is fully funded by Defra with technical knowledge and support provided by the Environment Agency. The outputs from this project will be used by Defra and the Environment Agency to support policy development and regulation. The final report will be published and therefore may be used by stakeholders including NGOs and academia in the field of POPs and destruction of waste chemical content or by others internationally, including Parties to United Nations Stockholm and Basel Conventions.

**Project Outputs:**

1. An initial project plan detailing the proposed methodology, including the sites selected, sampling schedule, number of samples taken per site, chemicals being analysed and the approach to assessing destruction efficiency. This project plan will need to be agreed with by the authority prior to the start of sampling.
2. A written report meeting the objectives and requirements set out in the work packages below. The report should include the following:
   * Details of the waste being received by the facilities being sampled including waste type and quantity, with specific consideration of whether or the not the facility receives waste domestic seating alone or as part of a mixed waste or receives the separated WEEE plastics from a density separation plant (which would typically be as part of SRF or RDF).
   * Specification of the incinerators being run at the facilities being sampled including furnace type, thermal input in megawatts (MW), primary and secondary measure for dioxin control, average operating temperatures and other relevant technical data.
   * The results of PBDD/F emissions monitoring and residue sampling from 6 MWIs in England (3 that are taking specific waste streams containing brominated POPs and 3 that are not) with 3 samples taken for each plant.
   * The results of the POP PFAS in the APC residue and bottom ash compared to POP waste limits.
   * An analysis of the results to consider destruction of BFR’s and brominated POPs, impact of emissions to air and residues.
   * A calculation of destruction efficiency for POP BFRs, according to the methodology proposed and agreed by authority.
   * Comparison of results to those reported in academic literature and relevant reports
   * The information provided in the report must be sufficient to allow Defra to draw conclusions around the suitability of MWIs for disposing of this material.
   * All sampling and analytical methodology used, including limits of detection, uncertainty, limitations and recommendations must be clearly documented within the report.
   * All spreadsheets/tables of raw anonymised data must be submitted to Defra at the end of the project, to allow, if necessary, further analysis to be undertaken either by Defra or externally.
3. An executive summary of no more than 2 pages that summarises the findings for an informed but non-technical policy audience

All outputs must be provided by email to the Defra Project Officer.

**Approach and Methodology:**

An outline draft project plan, including the proposed approach to each of the work packages and an outline timetable, must be submitted in the tender. This should include numbers of samples and proposed analytical methods for the target substances.

The authority suggests that the collection of samples should be carried out in conjunction with current monitoring contractors at the relevant sites.

The authority has suggested a list of target substances, this list will be confirmed with the Tenderer within the first Work Package, but capabilities to measure these substances should be detailed within the methodology.

Table 1. Suggested target substances for analysis

|  |  |
| --- | --- |
| Sample | Target substance |
| Air emission | Polybrominated dioxins and furans (PBDD/F) |
| Polychlorinated dibenzo p-dioxins and furans (PCDD/F) |
| Bottom ash and APC residue | PBDD/F |
| PCDD/F |
| Total bromine |
| Residual POP BFRs (polybrominated diphenyl ethers (PDBEs), octabromodiphenyl ether (octaBDE), pentabromodiphenyl ether (pentaBDE) and decabromodiphenyl ether (decaBDE) and hexabromocyclododecane (HBCDD)) |
| Other BFRs (decabromodiphenyl ethane (EBP), tetrabromobisphenol A (TBBPA)) |
| Dechlorane plus |
| Chlorinated paraffins: short chain chlorinated paraffins (SCCPs) and medium chain chlorinated paraffins (MCCPs) |
| Perfluorooctane sulfonic acid (PFOS) |
| Perfluorooctanoic acid (PFOA) |
| Perfluorohexane sulfonic acid (PFHxS) |

Tenderers will need to participate in regular fortnightly meetings with Defra and EA to discuss progress the project.

Tenderers will be expected to agree non-disclosure agreements with the operators and anonymise the results in the report.

**Work Package 1:** Agree site selection, sampling schedule and substances and detailed sampling and destruction efficiency methodology.

Agree with Defra and EA on the relevant sites selected, demonstrating that agreement from site operators has been sought. Agree non-disclosure agreements with the operators. Determine a detailed sampling schedule for each site, including the number of samples taken per site, when the samples will be sent for analysis and when the results are expected, including proposals for appropriate sampling and analysis methods for each substance. If a sub-contractor is being used, proof that they have agreed the schedule must be supplied.

A list of substances being analysed in the samples must also be agreed with the authority (see Table 1 for suggested chemicals for inclusion).

A methodology for determining the destruction efficiency for POP BFRs must also be proposed, for agreement by the authority. This should include consideration of how the amount of BFRs in waste fed into the incinerator will be determined, including consideration of the reasonable worst-case scenario. Standard approaches that have been adopted in other similar studies should be considered.

Sites selected should include at least one incinerator that currently receives waste domestic seating, and one that receives RDF/SRF containing the brominated WEEE plastic fraction from a density separation plant.

**Work Package 2:** Conduct air emission monitoring and residue sampling and laboratory analysis

Emission monitoring and residue sampling completed. Alongside recording/estimating the relevant information on the input material needed to allow assessment of destruction efficiency according to the agreed methodology. Appropriate testing methods should be used and samples should be representative. Undertake laboratory analysis of samples.

**Work Package 3:** Analyse sampling results and produce report

Report the anonymised results of the sampling and analysis. The report should include the data on the specification of the incinerators being run at the facilities sampled including furnace type, MW thermal input, primary and secondary measure for dioxin control, average operating temperatures and other relevant technical data. The results for anonymised sites must include emissions of brominated and chlorinated dioxins and furans (PBDD/F and PCDD/F) in emissions to air and concentration of BFRs, bromine content PCDD/F,PBDD/F and POP PFAS in the samples of the bottom ash and APC residue. The report must also include the estimates of POP BFR destruction efficiency.

**Timetable: (TO EDIT based on updated timelines)**

The below timetable is indicative and to be finalised and agreed with the contractor at the inception meeting. The project will start the March 2023.

Tenderers should allow time for review of reports and Defra quality assurance, including possible internal review of final report and project outputs.

|  |  |  |
| --- | --- | --- |
| **Milestones** | **Deliverables** | **Deadline** |
| Inception meeting | Kick off meeting with Defra and EA | May 2023 |
| Progress updates | Fortnightly online meetings/calls on progress to update Defra project officer on progress, with EA if required | Ongoing throughout project |
| Work package 1 | Initial project plan and agree WP1 with Defra and EA | June 2023 |
| Work package 2 | Complete the sampling and analysis in WP2 | September 2023 |
| Draft final report | Draft report including sampling data, analysis, and recommendations | mid-October 2023 |
| Report meeting | To discuss draft final report and comments | End of October 2023 |
| Work package 3 | Submission of final report WP3 | Mid-November 2023 |
| Contract end |  | 31st January 2024 |

**Financial Arrangement**

Tenderers must submit a proposed project delivery plan including interim deliverables and milestone dates. The proposed project delivery plan should identify the costs for delivery of each work package

Payment will be in accordance with project milestones agreed with the successful Tenderer following the award of the contract.

Technical Evaluation Questions

If the bidder passes the technical stage, the commercial stage will be evaluated. The technical stage is worth **70%** and commercial stage is worth **30%.**

# Scoring Criteria (for information)

* **For a score of 100:** Excellent – Response is completely relevant and excellent overall. The response is comprehensive, unambiguous and demonstrates a thorough understanding of the requirement and provides details of how the requirement will be met in full providing additional added value.
* **For a score of 70:** Good – Response is relevant and good. The response demonstrates a good understanding and provides details on how the requirements will be fulfilled.
* **For a score of 50:** Acceptable – Response is relevant and acceptable. The response provides sufficient evidence to fulfil basic requirements.
* **For a score of 20:** Poor – Response is partially relevant and/or poor. The response addresses some elements of the requirements but contains insufficient / limited detail or explanation to demonstrate how the requirement will be fulfilled.
* **For a score of 0:** Unacceptable – Nil or inadequate response. Fails to demonstrate an ability to meet the requirement.

If a score of twenty or zero is awarded to a response to one (1) or more of questions E01 – E05 the Authority may choose to reject the Tender.

# Technical Questions

## **E01 Organisational Experience, Capability and Resources (Weighting: 20%)**

Please describe your organisation’s capability in delivering research projects that are relevant or comparable to this specification. Please include a list of up to 5 references to relevant publications and or projects that your organisation has managed within the last 5 years. The Authority will not consider projects above the first 5 references, or projects that are provided without dates. Please describe any resources that you think are relevant to the delivery of the project such as asset and risk management, interpretation and understanding of legislation, undertaking evidence reviews and undertaking and interpreting stakeholder engagement and a variety of complex and conflicting views.

It is expected that your organisation or sub-contractors carrying out the stack emissions monitoring hold MCERTS (or ISO 17025) accreditation for EN 1948-1. In addition, the analytical laboratory analysing the samples should be accredited to EN 1948-2 and -3. Where possible this should include details of your organisation’s and where applicable your sub-contractor’s experience in delivering research detailed in this specification. Please include details of the number of years your organisation or the proposed team has been involved in the activities related to this project specification. Please demonstrate the proposed project team’s relevant skills and expertise in relation to the needs of the project

Your response must be a maximum of 2 sides of A4, font size 12. Please upload a document with the filename: “E01 - Your Company Name”. Any responses exceeding two sides of A4 will not be evaluated beyond the second side.

Please provide details of the proposed project team and team structure that you intend to use to deliver this project. CVs for each team member must be submitted to support your response (these are in addition to the above page limit). Evaluation criteria

Higher marks will be awarded to submissions which demonstrate:

* That the expected relevant accreditations are held by your organisation, sub-contractors and any laboratories used for sample analysis.
* Significant and relevant recent experience and capability of effectively delivering comparable projects to those required for delivering these Services.
* Overview of relevant resources to deliver this project such as asset and risk management, interpretation and understanding of legislation, undertaking evidence reviews and undertaking and interpreting stakeholder engagement and a variety of complex and conflicting views.

# E02 Understanding Project Objectives (15%)

Please provide an overview of your understanding of the project and the objectives of the research. This section should demonstrate your understanding of the project, the key issues/challenges involved in carrying out the research, provide an overview of how your recommended approach and method will address the research aim and objectives and the questions posed.

Your response must be a maximum of 3 sides of A4, font size 12 (including diagrams). Any responses exceeding 3 sides of A4 will not be evaluated beyond the third side. Links to other documents will not be considered as part of your response e.g., links to published documents online. Please upload a document with the filename: “E02 Your Company Name”.

### Evaluation Criteria

Higher marks will be awarded to submissions which demonstrate:

* An understanding of the rationale and context for the project, and not simply a copy of the ITT.
* An awareness of the key issues and challenges in relation to carrying out the project and achieving the aims and objectives, and how these will be managed.
* Clearly show how your overall recommended approach will address each of the aims and objectives.
* Clearly show how your overall recommended approach will address the research questions.

# E03 Approach and Methodology (Weighting 35%)

Please detail the methodology to be adopted to meet the project aims and objectives. The Tenderer should set out in detail each element of the methodology and how this will be carried out, including the approach, design, analytical analysis and any related risks. The Tenderer should demonstrate their knowledge of relevant research approaches that could be used and suggest an appropriate methodology that will deliver the full scope of requirements in the specification. Any input required from the Authority should be outlined, as well as the approach to disseminate the findings.

Your response must be a maximum of 8 sides of A4, font size 12. Any responses exceeding 8 sides of A4 will not be evaluated beyond the eighth side. Links to other documents will not be considered as part of your response e.g., links to published documents online. Please upload a document with the filename: “E03 Your Company Name”.

### Evaluation Criteria

Higher marks will be awarded to submissions which demonstrate:

* A clear approach to each of the aims and objectives.
* Understanding of how the methodological elements will link together and answer the research questions.
* How each element of the specification of requirements will be fulfilled.
* An awareness of appropriate dissemination activities.
* An awareness of risks associated with the methodological approach, including risk rating and proposed mitigation measures.
* The level of input and guidance that the successful supplier will require from the Authority.

# E04 Proposed Project Team (Weighting: 20%)

Please provide details of the proposed project team and team structure that you intend to use to deliver this project, including any sub-contractors and/or associates. CVs for key staff should be submitted to support your response (max 2 A4 sides per CV).

In your response, please include a table showing the staff days expected to be spent on the project per task, including both specialists and assistants. This table should match the staff days provided in Appendix D.

Please identify the individual(s) who will have overall management responsibility for the research and/or identify the Project Director and nominate a representative for day-to-day contact with the Authority’s Project Officer.

Your response must be a maximum of 2 sides of A4 font size 12. Please also include details within Appendix D. Any responses exceeding 2 sides of A4 will not be evaluated beyond the second side. Links to other documents will not be considered as part of your response e.g., links to published documents online. Please upload a document with the filename: “E04 Your Company Name”.

### Evaluation Criteria

Higher marks will be awarded to submissions which demonstrate:

* Senior staff are putting sufficient time into the key phases of the project.
* The individuals who make up the proposed team have sufficient and relevant experience, influence/authority and capability to successfully deliver this project.
* The size and structure of the proposed project team is sufficient to ensure that adequate resources have been allocated for all of the required roles and responsibilities.
* If there are proposals for consortium/sub-contracting arrangements, they are comprehensive and reasonable and there are measures are in place to effectively manage these arrangements throughout the contract.
* The experience of the staff proposed is appropriate to the roles allocated.
* Staff retention plans are in place to minimise turnover of key staff members.
* The individuals who will fulfil key roles e.g., Project Director and Project Manager.

# E05 Project Management (10%)

Please detail the adequacy of the proposed project management arrangements including day to day working for the project, the proposed timetable for the project, risk log and mitigation actions and Gantt chart.

Your response must be a maximum of 2 sides of A4, font size 12, and one side of A3 for the Gantt Chart. Links to other documents will not be considered as part of your response e.g., links to published documents online. Any responses exceeding 2 sides of A4, and one side of A3 for the Gantt Chart will not be evaluated beyond the last page. Please upload a document with the filename: “E05 Your Company Name”.

### Evaluation Criteria

Higher marks will be awarded to submissions which demonstrate:

* Your organisational approach to project management and how this is implemented.
* How you plan to keep the authority informed of progress made and any difficulties encountered. You must address a minimum of fortnightly calls and monthly progress reports.
* A Gantt Chart presenting timelines and inter-dependencies between work streams, particularly sequencing of work, and a float after each task.
* Clear risk register identifying project risks, cause, level of risk, likelihood of risk and action required to mitigate against the risk occurring.

| Stakeholder Name | Role in Procurement Activity | Organisation |
| --- | --- | --- |
| Gabrielle Edwards | Budget Holders | Defra |
| Liz Lawton | Contract Manager and Lead Technical Evaluator (a) | Defra |
| Ben Freeman | Technical Evaluator (b) | Environment Agency |
| Bob McIntyre | Technical Evaluator (c) | Environment Agency |
|  |  |  |
|  |  |  |
| Jennifer Allen | Commercial Manager | Defra – Defra Group Commercial |

1. Basel Technical guidelines available online: <http://www.basel.int/Implementation/TechnicalMatters/DevelopmentofTechnicalGuidelines/TechnicalGuidelines/tabid/8025/Default.aspx> [↑](#footnote-ref-2)
2. UN Stockholm Convention available online: http://www.pops.int/TheConvention/Overview/tabid/3351/Default.aspx [↑](#footnote-ref-3)
3. Regulation (EU) 2919/1021 of the European Parliament and of the Council available online: <https://www.legislation.gov.uk/eur/2019/1021/contents> and The Persistent Organic Pollutants (Amendment) (EU Exit) Regulations 2020 available online: https://www.legislation.gov.uk/uksi/2020/1358/contents/made [↑](#footnote-ref-4)
4. Keeley-Lopez P., Turrell J. and Vernon J. (2020). An assessment of the levels of persistent organic pollutants (POPs) in waste electronic and electrical equipment in England and Wales. Water Research Centre Limited (WRc) for Industry Council for Electronic Equipment Recycling (ICER). Available online: <https://icer.org.uk/wp-content/uploads/2020/03/UC14161.3-An-assessment-of-the-levels-of-persistent-organic-pollutants-POPs-in-waste-electronic-and-electrical-equipment-in-England-and-Wales-FINAL-REPORT.pdf> [↑](#footnote-ref-5)
5. Wood (unpublished). POPs MMEI (ECM\_52296): Work Package 5. DecaBDE and HBCDD within soft furnishings. [↑](#footnote-ref-6)
6. Keeley-Lopez P., Turrel J., Peppicelli C. and Vernon J. (2021). An Assessment of Persistent Organic Pollutants (POPs) in Waste Domestic Seating. Water Research Centre Limited (WRc). Report Reference UC15080.5. Available online: <https://www.circularonline.co.uk/wp-content/uploads/2021/10/WRc-Final-Report_UC15080.5_An-assessment-of-persistent-organic-pollutants-in-waste-domestic-seating_270521.pdf> [↑](#footnote-ref-7)
7. IPEN (2021). Non-combustion technology for POPs waste destruction: Replacing incineration with clean technology. Available online: <https://ipen.org/sites/default/files/documents/ipen-noncombustion-en-v1_2aw.pdf> [↑](#footnote-ref-8)
8. UNEP (2017). Technical guidelines. Addendum. General technical guidelines on the environmentally sound management of wastes consisting of, containing or contaminated with persistent organic pollutants. UNEP/CHW.13/6/Add.1. Available from: <http://www.basel.int/TheConvention/ConferenceoftheParties/Meetings/COP13/tabid/5310/Default.aspx> [↑](#footnote-ref-9)
9. Defra (2020), Methods for the pre-treatment and destruction of persistent organic pollutants. Evidence Statement 11. Available online: <http://randd.defra.gov.uk/Document.aspx?Document=14870_ES11_DestructionofPOPs_FINAL.PDF> [↑](#footnote-ref-10)
10. Environmental Services Association (ESA): A sampling and testing protocol to assess the status of incinerator bottom ash (IBA) available online: <https://www.esauk.org/application/files/7915/3589/6448/20180130__IBA__Protocol_revised_-_Jan_2018_version.pdf> [↑](#footnote-ref-11)
11. Guidance on the classification and assessment of waste (first edition v1.2.GB) Technical Guidance WM3. available online: <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1021051/Waste_classification_technical_guidance_WM3.pdf> [↑](#footnote-ref-12)