Written by the Specialist Advisory Group (SAG):

Eulyn Pagaling (Chair)[1], Lucinda Robinson (Secretariat)[1], Michelle Bloor[2], Laura Carter[3], Efthalia Chatzisymeon[4], Stuart Harrad[5], Andreas Kolb[6], Martin Sharkey[7], Anna Stec[8], Zulin Zhang[1], Ioanna Akoumianaki[9], Lorna Dawson9

Affiliations
1. The James Hutton Institute
2. University of Glasgow
3. University of Leeds
4. University of Edinburgh
5. University of Birmingham
6. Rowett Institute, University of Aberdeen
7. University of Galway
8. University of Central Lancashire
9. SEFARI

Persistent Organic Pollutants (POPs) in Waste: Emerging Treatment Technologies

Policy Brief

Scottish Government
Riaghaltas na h-Alba
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Objective 1: Detect and Separate POPs

Key POPs:

Brominated flame retardants and PFAS found in construction, vehicles, furniture, and electronics.

Technologies:

Density separation: Mature, low-cost, but crude.

XRF: Fast, detects bromine, but lacks specificity.

Challenges: Limited throughput, no UK verification labs, poor detection of chlorinated/fluorinated POPs.

Policy: Expand testing and invest in complementary methods such as spectroscopy.

Objective 2: Treat POP Waste

Current state: Incineration dominates.

Emerging methods:

Creasolv: Extracts POPs from foam (TRL 7). Thermal: Pyrolysis/gasification—potential but risky.

AOPs: Can destroy POPs but may leave toxic residues.

Biological: Promising but unproven at scale.

Policy: Fund pilot testing and infrastructure to reduce incineration.

Objective 3: Tech Benefits, Limits, Readiness

TRLs:

High: Incineration, XRF, density separation.

Mid: Creasolv, some AOPs.

Low: Pyrolysis, bioleaching, microwave extraction.

Benefits: Some methods are cheap, non-destructive, and enable recycling.

Limits: High cost, toxic by-products, limited scope.

Policy: Support innovation via funding and regulation.

Objective 4: R&D and Implementation in Scotland

Barriers: Strict thresholds, poor chemical transparency, few facilities, weak business models.

Opportunities:

Better coordination across sectors.

Domestic testing labs.

Product passports for chemical tracking.

Policy: Scotland can lead by piloting circular economy solutions and reducing reliance on incineration.

Objective 1: Detect and Separate POPs - Summary Table

Technology	Readiness	Benefits	Limitations	Policy Recommendation
Density Separation	TRL 9	Low-cost, mature	Crude, limited discrimination	Invest in complementary methods
XRF	TRL 9	Fast, cheap	False positives, limited scope	Expand testing capacity

Objective 2: Treat POP Waste - Summary Table

Technology	Readiness	Benefits	Limitations	Policy Recommendation
Creasolv	TRL 7	Enables plastic recycling	Lab-scale, limited scope	Pilot-scale testing
Pyrolysis/Gasification	TRL 3–5	Potential by-products	Toxic residues, high energy	Infrastructure investment
AOPs	TRL 6–7	POP destruction	Persistent by-products	Evaluate scalability
Biological Methods	TRL 3–5	Promising	Unproven at scale	Support R&D

Objective 3: Tech Benefits, Limits, Readiness – Summary Table

Technology	Readiness	Benefits	Limitations	Policy Recommendation
Incineration	TRL 9	Widely used	High carbon impact	Seek alternatives
XRF/Density Separation	TRL 9	Cheap, non-destructive	Limited scope	Support innovation
Creasolv	TRL 6–7	Recycling over destruction	Limited to specific plastics	Fund demonstration projects
Pyrolysis/Bioleaching	TRL 3–5	Secondary products	Toxic by-products	Regulatory incentives

Objective 4: R&D and Implementation in Scotland - Summary Table

Barrier/Opportunity	Details	Policy Recommendation
Regulatory Thresholds	Push waste to incineration	Reform to incentivise innovation
Chemical Transparency	Lack of disclosure	Introduce product passports
Facilities & Workforce	Limited capacity	Invest in domestic labs
Business Models	Low profitability	Create demand through regulation

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info@sefari.scot

@SEFARIscot

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