Northern Ireland Assembly

Knowledge Exchange Seminar Series (KESS)

Beach Clean 2.0: a transdisciplinary, civic approach to tackling marine plastic pollution in Northern Ireland

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KESS Policy Briefing

...is a forum that encourages debate on a wide range of research findings, with the overall aim of promoting evidence-informed policy and law-making within Northern Ireland

Key points:

- This policy brief responds to the 'Fisheries and Water Environment' Bill
- The briefing details a new, civic approach to harvesting marine plastics and creating a circular plastic valorisation model
- Marine plastic pollution remains a complex obstacle to oceanic health and societal wellbeing
- On average, 500 pieces of litter are recorded for 100m stretch of NI coastline
- Beach cleaning remains an effective activity for marine litter removal
- Over 6,000 people are registered with NI beach clean groups
- Beach cleaning and recreational litter picking denotes a form of 'enviro-leisure activism', stimulating both environmental and recreational motivations and values
- Beach Clean 2.0 is transdisciplinary research enabling a green transition by purposefully reimagining beach cleaning and circular waste management by combining community participation, material science and design
- Beach Clean 2.0 comprises an interdisciplinary and inter-sectoral team of academics, industry partners, local council representatives, community-and voluntary sector organisation representatives, devolved government department members and NI civil servants
- The project informs the proposed 'Fisheries and Water Environment' Bill in three ways:
    - Providing a waste valorisation pathway for fishing waste, such as twine and rope
    - Multi-stakeholder partnership collaboration for water-land-edge environments
    - Addressing rural community needs through coastline conservation
- The Beach Clean 2.0 methodology incorporates Positive Design principles, enabling beach cleaners to sort marine litter in situ, ready for polymer processing
- Testing demonstrated good and very good scores for all three Positive Design dimensions
    - Significance: effectiveness (very good) and efficiency (good)
    - Pleasure: satisfaction (good) and ease (good)
    - Virtue: trust (very good) and value (good)
- A Beach Clean 2.0 Toolkit is available free of charge under common licence
- Proof of Principle has been demonstrated for processing beach litter (rope, braided twine and rigid plastics) as 3D printing filament and for blended compression moulding
- The research identifies three core challenges:
    - Plastic Waste Journey Gap
    - Industry Readiness
    - Community Empowerment
- Several policy recommendations arise: 1) to establish a clear line of responsibility with central actors overseeing facilitation of both beach and waste management; 2) revise and incentivise council and public tendering and procurement policies for construction, marine or related sectors to blend 5-10% of beach waste into plastic processing; thereby supporting a closing of NI's circularity gap; and 3) policy can provide an accelerator in the adoption of this best practice, by linking government to environmental and community sector organisations funding to embedding circularity principles of Beach Clean 2.0
- Call for Action: Join the Beach Clean 2.0 Task-and-Finish Group

Beach Clean 2.0: A civic approach to harvesting marine plastics

This policy brief responds to the KESS Call List 'Fisheries and Water Environment' Bill and provides insights from research presented at the Irish Environmental Research Colloquium (see Power et al. 2025a) and available via an Open Access Research Impact Card (see Power et al. 2025b). The findings and recommendations provided in this policy brief build on existing research by Power (2022) on community beach cleaning, Magee's (2024) work on waste valorisation through co-design and Millar's (O'Rourke et al. 2024) research on polymer processing. The resulting research is entitled Beach Clean 2.0 - a transdisciplinary research project tackling a persistent water-land-edge environmental issue.

Marine plastic pollution remains a complex obstacle to oceanic health and societal wellbeing. Keep Northern Ireland Beautiful (KNIB 2026) reports on average 500 items of litter for each 100m stretch of beach in Northern Ireland. This is significantly above the 20 items per 100m threshold for beach health as stipulated by the OSPAR Commission (2010). KNIB further note that 85% of beach litter is made from some type of plastic. The novel Beach Clean 2.0 methodology has enabled the conversion of 36%-75% of beach plastics from objects of waste to materials of use; thus, diverting it from landfill. Beach Clean 2.0 provides a conduit to improving the aquatic environment through a circular marine waste ecosystem design.

Beach cleaning by volunteers remains a crucial part in the complex beach maintenance system. The 2025 Great British Beach Clean mobilised 6,482 beach clean volunteers over one week of action (MCS 2026). This is a critical mass of people volunteering to contribute oceanic and coastal health. Beach clean groups play a major role in the facilitation of this recreational activity (Power 2022). The number of beach cleaners in Northern Ireland registered to a beach clean group surpassed 6,000 at the start of 2026. Furthermore, in addition to litter removal, beach cleaning is known to have a positive effect on wellbeing of participants (Wyles et al. 2017). Recreational litter picking should not be reduced to purely a form of environmental activism. Research has shown that the leisure component of beach cleaning, spending quality time with family and friends and the unifying identity of beach clean groups are fundamental aspects to this civic movement (Power 2022). The ecosystem of beach cleaning can also be understood as a form of 'enviro-leisure activism' (Power 2022).

Beach Clean 2.0 is transdisciplinary research enabling a green transition by purposefully reimagining beach cleaning and circular waste management by combining community participation, material science and design. The Beach Clean 2.0 ecosystem consists of a developing multitude of stakeholders, embracing a multi-agency approach. Figure 1 visualises the Beach Clean 2.0 Ecosystem Stakeholder Map.

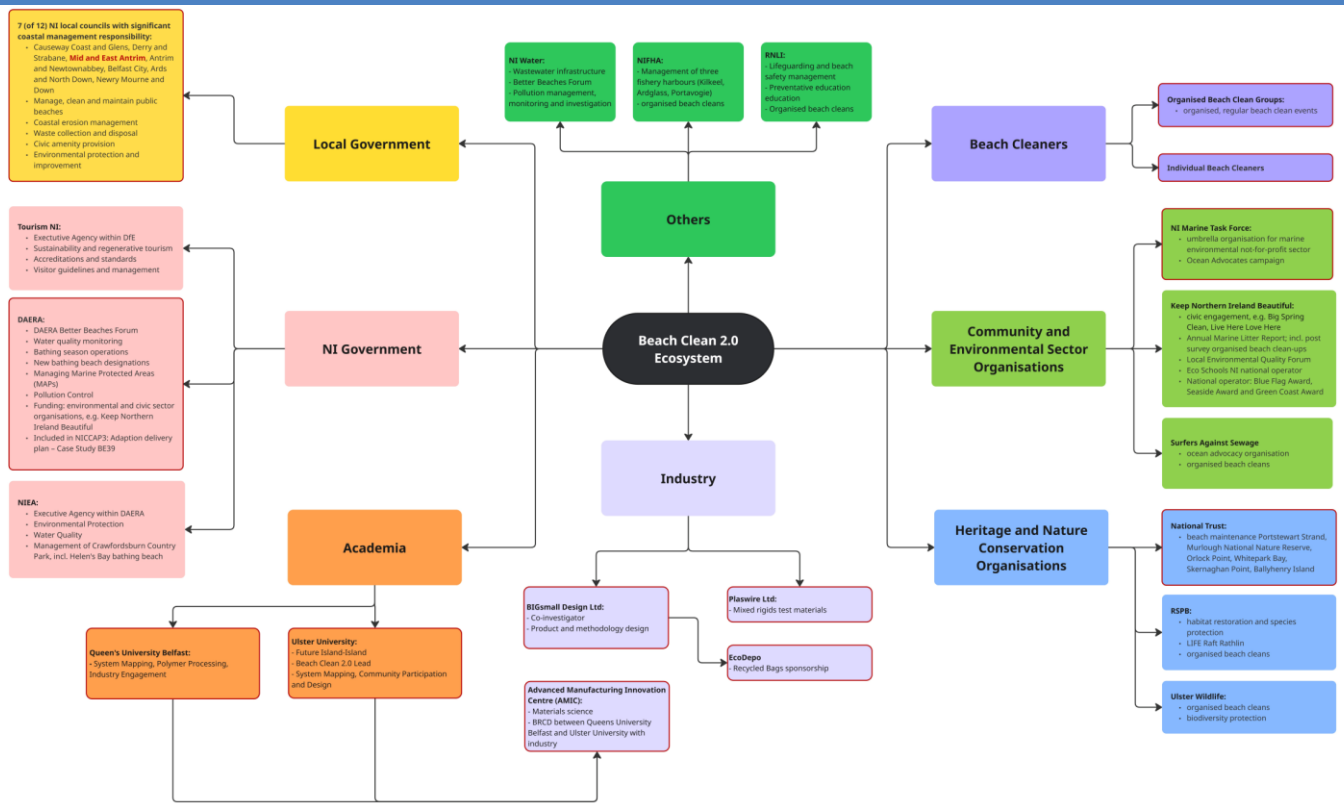

Figure 1: Beach Clean 2.0 Ecosystem Stakeholder Map

Stakeholders featuring a red box frame are currently actively involved in the Beach Clean 2.0 research via a Task-and-Finish Group. Beach Clean 2.0 addresses several policy intentions of the 'Fisheries and Water Environment Bill'. First, the research provides waste valorisation pathways for fishing waste such as rope and twine; thus, supporting waste management of commercial fishing and recreational angling; both in in-land and sea environments. Second, the green transition Beach Clean 2.0 methodology activates multi-stakeholder partnerships for the improvement of water-land-edge environments. Third, by improving water-land-edge areas, the research impacts positively on business and tourism in rural/coastal areas that rely on clean environments; thus, addressing rural community needs.

Co-design of Beach Clean 2.0 service experience and products

Beach Clean 2.0 adopts the Positive Design Framework (Desmet & Pohlmeyer 2013) through a process of iterative co-design with beach cleaners in Northern Ireland. Figure 2 visualises the design concept adapted for Beach Clean 2.0. Embedded in the Positive Design Framework are dimensions of Pleasure (Ease and Satisfaction), Virtue (Trust and Value) and Significance (Effectiveness and Efficiency). The initial design was provided by co-investigator and industry partner BIGsmall Design Ltd comprising a set of coloured bags for material sorting and an explainer card for participants. As part of an iterative design-test

phase with the beach cleaning community, various bag holder options were refined for ease of carrying. This holder, the size of the bags and the explainer card continue revision following further testing to its current form, which can be seen in Figure 3.

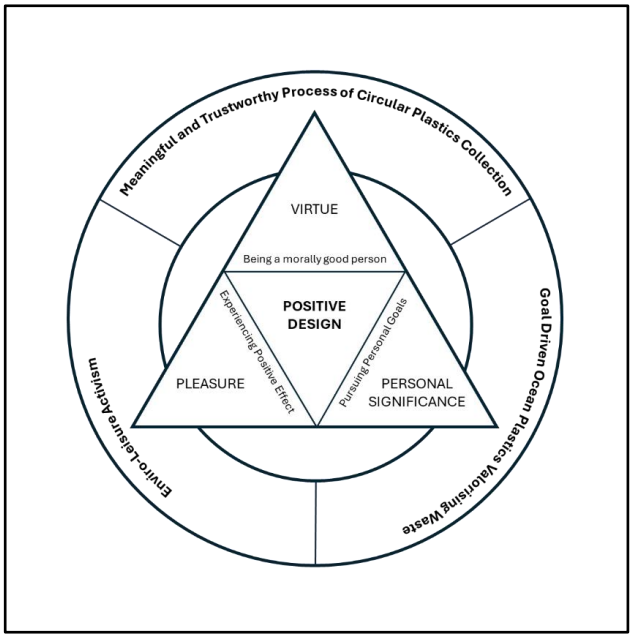

Figure 2: Positive Design Framework

Figure 3: Design Items Beach Clean 2.0

The iterative testing and co-design with beach cleaners involved three separate testing incidences, 146 participants and 221.8kg of collected litter. Compliance with the separation guidelines as per explainer (see Figure 3) was high with 82.5% for braided rope, 87.5% for twine and 100% for rigid plastics. Non-compliance items related to entangled litter or organic lifeforms such as seaweed. Participants were then asked immediately after each beach clean to complete a short survey utilising the Useability Metric for User Experience (UMUX); a simple, subjective yet validated user experience test (Finstad 2010), suited to simple processes and time efficiency, such as Beach Clean 2.0. With 84 responses across three iterations of the product, results are encouraging across all three dimensions of the Positive Design Framework. (NB: A score of 70 is the threshold for good, while 80 denotes excellent user experience, both of which indicate a system that is easy to use and suitable for its intended purpose).

1) Significance: Effectiveness (77.8) and Efficiency (67.5)

2) Pleasure: Satisfaction (69.6) and Ease (64.7)

3) Virtue: Trust (79.2) and Value (71.0)

Since then, further design iterations have been made to improve ease and efficiency scores and will be tested during the summer bathing season 2026 with the aid of the Beach Clean 2.0 Task-and-Finish Group. The design concept of Beach Clean 2.0 demonstrates that materials can be collected in a process that enables wider advocation into schools,

communities and corporate settings reinforcing environmental thinking. The design concept provides a simple recycling method for beach litter diverting it from landfill. Adopting the method across council areas will improve connection between education policies and waste stream management. Equally, the method creates a connection between people and waste or litter, which builds accountability in behaviour. Active engagement with environmental conservation practice also improves mental health and wellbeing, while the leisure component of Beach Clean 2.0 provides an opportunity to embed the activity within community events, tourism offering and exciting campaigns (e.g. Two Minute Beach Clean, International Coastal Clean-Up Day or The Big Spring Clean). The method and physical equipment are designed as an Open-Source service and system, available as a non-executive and non-commercial licence (Beach Clean 2.0 Toolkit).

Value stream of materials and environmental clean-up

The research team has provided Proof of Principle for processing beach litter (rope, braided twine and rigid plastics) as 3D Printing filament and blended compression moulding, highlighted as a case study for the Advanced Manufacturing Innovation Centre (AMIC 2025). The 3DP processing is currently being refined as circular plastics blend recipes as stock materials, supported by a DfE funded PhD at Ulster University, whereas compression moulded beach litter can provide stock material for low-risk sections, e.g. some aspects of construction. The processing method has potential to apply to fishing waste on a larger scale, pending better readiness levels. A landscape review of the plastic processing ecosystem in Northern Ireland is currently underway with support from the Beach Clean 2.0 Task-and-Finish Group, WRAP, the Strategic Investment Board NI and DAERA.

Challenge and policy needs

To scale Beach Clean 2.0 from Proof of Principle to an NI-wide adoption, we identify a number of challenges and associated policy needs; leading to recommendations for consideration when legislating especially for the new 'Fisheries and Water Environment' Bill and the improvement of water-land-edge environmental quality.

Challenge 1: Plastic Waste Journey Gap

Beach Clean 2.0 provides a robust methodology for on-site waste separation in addition to a valorised plastic processing proof of principle. The challenge lies in the waste journey from the point of collection by the beach cleaner to the plastic processor. To facilitate this, a multi-agency approach is required. The newly established Task-and-Finish Group seeks to develop pathways for the plastic journey. However, coastline management and waste management varies across each council area. For bioregions, such as coastlines, decentralisation can be hazardous. Policy, thus, needs to establish a clear line of

responsibility with a central actor overseeing facilitation or both beach and waste management.

Challenge 2: Industry Readiness

A landscape review has identified a dearth of commercial entities willing to engage in beach and fishing gear litter related plastic processing. This is not due to the lack of capability; instead, reluctance is borne out of a lack of commercial incentives. A new database is under development which is identifying gaps in sectoral knowledge and will inform visual diagrams to help declutter the plastics processing capabilities and pathways in Northern Ireland, suitable for circular material processing. Policy can provide such incentives by revising council or public tendering policies and providing a positive provocation for a push towards a positive supply network. This could take the form of tax or tendering incentive for construction, marine and other sector to blend 5-10% of beach waste into their plastic processing. Such a policy would support measures for filling the NI circularity gap as outlined in the Draft Circular Economy Strategy, the Draft Green Growth Strategy, the forthcoming Environmental Improvement Plan and Plastic Pollution Plan.

Challenge 3: Community Empowerment

Despite a large number of active beach cleaners in Northern Ireland, buy-in from environmental and community sector organisations is crucial for the success of Beach Clean 2.0 and circular ocean plastic waste management. Involvement with educational partners, such as Eco-Schools NI is equally instrumental to the success of this civic approach to waste valorisation. The Open-Source method makes Beach Clean 2.0 cost effective. The method has scored excellent for Trust and Value among beach cleaners; thus, policy can provide an accelerator in the adoption of this best practice, by linking government funding for environmental and community sector organisations to embedding the circularity principles of Beach Clean 2.0 into their campaigns and activities. Furthermore, while Beach Clean 2.0 in its present form can directly relocate marine plastics into the blue bin municipal waste stream or to AMIC, the plastics waste journey gap and industry readiness needs to align to make it easy for beach cleaning communities to supply harvested plastics directly into the circular processing ecosystem. Here, ease of recycling is a known barrier to recycling plastics (Roy et al. 2022).

Call for Action:

Having established an emergent, multi-agency and interdisciplinary Task-and-Finish Group for Beach Clean 2.0, we encourage wider participation from relevant stakeholder groups, especially relating the three abovementioned challenges.

Beach Clean 2.0 is part of Future Island-Island, an AHRC-funded project that brings together community members, academics, and practitioners to co-create design-led research for a greener, more sustainable Northern Ireland Economy.

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