BLUE CIRCULAR ECONOMY

Northern Periphery and Arctic Programme 2014–2020

EUROPEAN UNION
Investing in your future
European Regional Development Fund

LOCAL INNOVATION SYSTEMS RELATED TO WASTE FISHING GEAR

Research report on the findings from stakeholder workshops related to local innovation systems related to waste and “end of life” fishing gear

Professor Martin Charter, Director, The Centre for Sustainable Design®, Business School for The Creative Industries, University for the Creative Arts, and Paul Whitehead, Western Associates

March 2022

DTU Technical University of Denmark

The Centre for Sustainable Design®

NTNU Norwegian University of Science and Technology

WESTERN DEVELOPMENT COMMISSION

eri environmental research institute

BLUE CIRCULAR ECONOMY

The Blue Circular Economy (BCE) is a three-year initiative to help Small and Medium-Sized enterprises (SMEs) to attain a greater market reach by offering products and services, and fishing gear recycling solutions.

The BCE mission is to generate sustainable business opportunities and solutions related to waste and “end of life” fishing gear through informed, innovative and collaborative efforts, for the benefit of enterprises, local economies, and the environment in the NPA region.

The vision is to create the ecosystem, knowledge and industry necessary to address the FNRCPs marine plastic waste problem by fostering a vibrant industry for the recycling and reuse of used fishing nets, ropes, components and peripherals.

Established in 2018 the Blue Circular Economy is a partnership between Norwegian University of Science and Technology, Western Development Commission, Technical University of Denmark, The Centre for Sustainable Design® at UCA, and the Environmental Research Institute. The three-year programme is funded under the European Regional Development Fund (ERDF) Northern Periphery and Arctic 2014-2020 programme (http://www.interreg-npa.eu/).

Full details on www.bluecirculareconomy.eu

CONTENTS

1. INTRODUCTION

Blue Circular Economy (BCE) is a transnational project, funded by the Northern Periphery and Arctic (NPA) Programme of the European Commission (EC), that helps Small and Medium-Sized enterprises (SMEs) offering products and services derived from waste and "end of life" fishing gear, or fishing gear recycling solutions, to attain market reach. BCE is led by International Business Department at NTNU in Ålesund, Norway. The Centre for Sustainable Design® (CfSD), Farnham, Surrey, UK[1] at the Business School for Creative Industries[2] - at the University for the Creative Arts[3] - is a partner in the project.

Despite its geographical differences, the NPA region shares several common features, such as low population density, low accessibility, low economic diversity, abundant natural resources and high impact of climate change (see Annex 0). This unique combination of features results in joint challenges and opportunities that can best be overcome and realised through co-operation. For example, there are similar issues in different parts of the NPA region associated with problems such as waste and "end of life" fishing gear, and the need to establish solutions to tackle the problem. Therefore, setting up a platform to share knowledge on lessons learnt related to waste and "end of life" gear, and developing new solutions to tackle the challenge could be useful for a range of stakeholders in the NPA region and outside.

Like other fishing regions around the world, the NPA region's waters and beaches suffer from fishing gear being lost or discarded. While that presents multiple problems, it opens up potential opportunities for businesses and social entrepreneurs.

In the EU, 27% (by count) of marine litter comprises plastic fishing gear, with single use plastics making up a further 43%[4]. Fishing gear[5] containing plastic poses a significant risk to marine ecosystems, biodiversity and human health. There are additional risks to marine-related economic activities including tourism and shipping. Analysis by United Nations Environment Programme

[1] www.cfsd.org.uk
[2] www.uca.ac.uk/business-school
[3] www.uca.uca.ac.uk
[4] Single use Plastics includes food containers; beverages cup, containers, caps & lids; packets & wrappers, tobacco product filters, sanitary items & wet wipes; lightweight plastic carrier bags
[5] The definition of 'fishing gear' is aligned to the definition used in the SUP Directive – Fishing Nets, Ropes, Components and Peripherals (FNRCPs). Peripherals include polymers, metals, rubbers etc.

UNEP) has suggested that 70%, by weight, of floating macro plastic debris, in the open oceans, is fishing-related.[6]

Waste fishing gear is increasingly being recognised as a key part of the ocean waste or marine litter problem and has gained further policy, media[7] and NGO attention. In October 2020, WWF reported that between 0.5 and one million tonnes of fishing gear that is lost or discarded in the world's oceans each year.[8] The repercussions on sea life can be enormous. For example, in the NPA region and an area (East Lothian) bordering it: in October 2019, Scottish Entanglement Alliance (SEA) reported that SEA project partners had responded to three entanglement cases – one involving a humpback whale, successfully freed from creel gear.

There are essentially two categories of waste fishing gear[9]: "end of life" of fishing gear; and abandoned, lost or discarded gear (ALDFG) which is commonly known as "ghost gear". "End of life" fishing gear is often left in piles in harbour facilities due to a lack of a waste management plan for fishing gear, which means it often goes to landfill or incinerators. Ghost gear is abandoned, discarded or accidentally lost fishing gear that fish or marine animal predators and scavengers can get caught in and, typically, die as a result.

As indicated above, the subject of plastics in the oceans and, specifically, waste and "end of life" fishing gear, has received increased attention from the media, NGOs, politicians and other stakeholders over recent years. As a result, the European Commission (EC) passed Single Use Plastics Directive (SUPD)[10] in July 2019 that included Extended Producer Responsibility (EPR) legislation for fishing gear. The EPR legislation is planned to be come into force in EC member states on 31st December 2024.

The EPR legislation embedded within the SUPD aims to tackle the many challenges posed by waste and "end of life" fishing gear made from plastics. The SUPD is based on the "polluter pays" principle:

[6] http://wedocs.unep.org/bitstream/handle/20.500.11822/7720/-Marine_plasctic_debris_and_microplastics_Global_lessons_and_research_to_inspire_action_and_guide_policy_change-2016Marine_Plastic_Debris_and_Micropla.pdf?sequence=3&isAllowed=y

[7] https://www.theguardian.com/commentisfree/2022/jan/19/dumped-fishing-gear-killing-marine-life-governments-care-scottish-trawlerman-nets#comment-154394954

[8] https://www.worldwildlife.org/stories/ghost-fishing-gear

[9] Point 1 of Article 3 of Directive 2008/98/EC defines 'waste fishing gear' as any fishing gear covered by the definition of waste in, including all separate components, substances or materials that were part of or attached to such fishing gear when it was discarded, including when it was abandoned or lost

[10] https://ec.europa.eu/environment/topics/plastics/single-use-plastics_en

the aim is to make fishing gear producers and/or assemblers responsible for the “end of life” phase of fishing gear by taking on the costs of managing the products’ waste streams.

Prior to implementation of the EPR there are legal requirements to collect and report data on fishing gear placed on the market and on waste fishing gear (containing plastic) collected in member states. In addition, implementation of the Port Reception Facilities (PRF) Directive will mean collection infrastructure will need to be set up for waste and “end of life” fishing gear. EPR will seek to increase the collection rate of waste and “end of life” fishing gear, thus reducing disposal at sea as well as disposal by landfilling and incineration, and the associated environmental and economic impacts of marine plastics.

Under the SUPD, member states will need to bring into force laws, regulations and administrative provisions to enable the introduction of EPR for fishing gear by the 31st December 2024. Member states will be able to design and implement tailored legal, administrative and economic instruments to create local solutions at ports and/or within fishing communities.

In 2027, the EC will evaluate the SUPD and may include new legislative proposals or binding collection targets related to the EPR of fishing gear.

Under EPR, member states will have the flexibility to develop EPR schemes in consultation with stakeholders including producers and assemblers of fishing gear, fishers, recyclers, SMEs, entrepreneurs, co-operatives or social enterprises.

New recycling infrastructure and facilities will need to be established and funded in European member states to achieve recycling targets after the introduction of EPR in December 2024. At present specialist recyclers related to waste and “end of life” fishing gear are limited, with Plastix Global[11] (mechanical recycler producing pellets) - and Aquafil (chemical recycler producing second life nylon fibres from nylon fishing nets under the Econyl[12] brand) - being the most established. However, new recyclers are beginning to be established throughout Europe.

Understanding the extent of the waste and “end of life” fishing gear challenge in Europe is still difficult to assess due to a lack of data at ports, harbours etc in the NPA region and elsewhere across Europe. Initial discussions have indicated that due to lack of predictability and relatively low volume

[11] https://plastixglobal.com/
[12] https://www.econyl.com/

of waste and “end of life” fishing gear arising from ports, harbours, etc, specialist recyclers may need to be established and located at a regional rather than a local port-city level. These early findings are supported by two case studies in this report (see Annex 1 and Annex 2).

Summary of key targets and dates

Year	Description
27/06/2019	Entry into force of the revised Port Reception Facilities (PRF) Directive.
02/07/2019	Entry into force of the SUP Directive.
03/07/2020	Entry into force of implementing acts laying down the format for reporting data on fishing gear (containing plastic) placed on the market and waste fishing gear collected.[13]
21/01/2022	Entry into force of implementing acts for PRF Directive[14] that requires the provision of collection facilities for passively fished gear, including ALDFG and “end of life” fishing gear.
2022	Member states need to collect and report data on fishing gear placed on the market and on waste fishing gear (containing plastic) collected in each member state. This will need to be completed annually.
2024	Member states will need to report the data and information collected electronically within 18 months of the end of the reporting year for which they were collected (first reporting year: 2022).
31/12/2024	Member states to have established EPR schemes for fishing gear (containing plastic).
07/2027	EC completes an evaluation of the SUP Directive. If appropriate, the EC will propose binding collection targets for waste fishing gear following a study of the feasibility of establishing such binding targets.

The development of products and/or services derived from or related to waste and “end of life” fishing gear may provide a stimulus for the creation of businesses, jobs and wealth within fishing communities in the NPA region and elsewhere.[15] To kick start activities, there is likely to be a need for investment in infrastructure to enable the fishing industry to become more circular. This might be

[13] The Commission Implementing Decision laying down the format for reporting data and information on fishing gear placed on the market and waste fishing gear collected in Member States and the format for the quality check reports was adopted on 31st May 2021. Please see the link here: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv%3AOJ.L_.2021.211.01.0051.01.ENG&toc=OJ%3AL%3A2021%3A211%3ATOC

[14] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32022R0089&from=EN

[15] https://cfsd.org.uk/wp-content/uploads/2016/10/Circular-Ocean_Research_Products_FINAL_23-04-18.compressed.pdf

through central or local government grants, or by companies raising funds e.g. crowdfunding, loans or venture capital or through public-private partnerships.

Key insights from a BCE report published in July 2020[16] should be considered when reading this report, as the findings reinforce topics and issues that are highlighted throughout. These include

- Fishing operators work to very tight margins and cannot afford their fishing gear to fail
- Fishing gear can be expensive, with some individual fishing gear costing up to €200k; however, some monofilament fishing nets are very inexpensive
- Fishing gear design and development often appears to follow informal processes based on key people's knowledge and experience in the company, rather than following a structured product design and development process as might be found in other market sectors
- Fishing gear is often assembled in Europe with materials and components procured from suppliers in India, China and South Korea
- Fishing gear is generally made to order; therefore, there is often a lot of dialogue between the fishers and fishing gear manufacturers and/or assemblers
- Customisation of fishing gear is very common, with adaption based on individual experience, leading to a variety of co-design of fishing gear by producers and fishers
- Fishing gear is typically repaired and modified by the fishers and/or sometimes by the fishing gear producers/assemblers as part of contracts

Since the above report was published, there has been growing visibility of the issue of marine plastics and more recently waste fishing gear at sea amongst the general public as a result of increased media coverage and the documentary "Seaspiracy".[17] In March and April 2021, for example:

- One review of the documentary "Seaspiracy" was headlined "A shocking indictment of the commercial fishing industry" - The Independent (30th March 2021).[18] One reader of the review commented, "I have lived by the sea for a number of years and often pick up some of the plastic that floods in on every tide. I'd estimate that at least 50% is fishing

[16] https://cfsd.org.uk/wp-content/uploads/2020/07/FINAL-V2-BCE-MASTER-CREATING-BUSINESS-OPPORTUNITIES-FROM-WASTE-FISHING-NETS-JULY-2020.pdf
[17] https://www.seaspiracy.org/
[18] https://www.independent.co.uk/arts-entertainment/films/reviews/seaspiracy-review-netflix-documentary-fishing-b1824324.html

net. It lands in great big clumps twisted up with fishing line and hooks and in countless smaller fragments. Sometimes I despair about the damage it must be doing to marine life. We are trashing the land, the rivers and the oceans."

- The headline of another review of "Seaspiracy" stated, "The hidden catch behind your fish and chips: As a Netflix documentary exposes an over-fishing crisis... how millions of tonnes of fishing gear cause almost half the plastic polluting swathes of our oceans"- Daily Mail (8th April 2021)[19]

This report provides the findings from two stakeholder workshops that focused on local innovation systems related to waste and "end of life" fishing gear that were organised in Ålesund, Norway on 27th November 2019 and Galway, Ireland on 22nd January 2020. This is supplemented by two case studies from Sweden and Canada (see Annex 1 and Annex 2). The case studies focus on best practice of local fishing gear recycling approaches in the Sotenäs Marine Recycling Centre (SMRC) in Sweden, and the Steveston Harbour Authority (SHA) fishing gear recycling scheme in British Columbia, Canada. Both case studies are based on extensive interviews with the experts involved.

The case studies highlight the approaches that have been taken to establish recycling schemes for waste and "end of life" fishing gear in the two locations, and the challenges and lessons learnt that can be considered by stakeholders involved in similar schemes. Both cases highlight business opportunities arising from the collection of waste and "end of life" fishing gear. In addition, the SMRC case study highlights activities being taken in preparation for the forthcoming EC's EPR legislation for fishing gear.

[19] https://www.dailymail.co.uk/news/article-9451249/The-hidden-catch-fish-chips.html

2. STAKEHOLDER WORKSHOPS RELATED TO LOCAL INNOVATION SYSTEMS

This report is one of series of outputs from the BCE project and focuses on lessons learnt from organising the two stakeholder workshops in Ålesund, Norway on 27th November 2019 and Galway, Ireland on 22nd January 2020.

The subject of each workshop was "Local Innovation Systems. Converting waste fishing nets into products" with a goal of bringing together stakeholders from business and fishing sub-systems in Ålesund and Galway to discuss issues related to waste fishing gear. This report provides findings and lessons learnt from these two workshops in relation to local solutions to waste and "end of life" fishing gear.

The workshops included attendees from fishing organisations, ports, businesses, academia, centres of innovation, local authorities, etc (see Annexes 3 and 4).

There was a good range of stakeholders that attended the workshops but participants, particularly in the Ålesund event, indicated that they would have liked to have seen more industry attendees at the meeting. Attendees at both events indicated that more information about how to collect discarded fishing equipment, including where collected fishing nets could be recycled, would have been useful.

The objectives of the workshops were to present and discuss the following

- Local innovation ecosystems and fishing community/networks in each port area (Ålesund and Galway)
- Interaction between stakeholders in each port area (Ålesund and Galway)
- Business opportunities related to converting waste fishing gear into products
- The potential for a BCE Lab©: a concept for an innovation lab aimed at generating products from waste and "end of life" fishing gear that might potentially be established in either/or both Ålesund and Galway

Within both stakeholder workshops, a series of presentations was completed, followed by interactive discussion in working groups that were aimed at addressing the objectives above. More details of the workshops can be found at https://cfsd.org.uk/projects/bce/workshops/

3. BCE STAKEHOLDER WORKSHOPS IN ÅLESUND AND GALWAY

3.1 Overall Lessons Learnt

A series of generic and specific lessons were learnt from the workshops organised in Ålesund[20] and Galway related to challenges and opportunities associated with waste and "end of life" fishing gear. Some of the lessons are cross-cutting and some are specific to the locations. The specific lessons learnt related to individual workshops are highlighted where appropriate using (Galway) or (Ålesund) at the end of each sub-section.

The key lessons learnt were:

3.1.1 Fishing Gear

- The wider issues related to waste and "end of life" gear associated with both the fishing and farming of both finfish and shellfish (aquaculture and open sea) need to be considered. Most of the discussion surrounding waste and "end of life" fishing gear tends to be dominated by conversations over gear for catching finfish, despite the aquaculture and shellfish sector contributing a significant proportion of the total fishing gear on the market. Figures are hard to come by, but, for example, shellfish landings in Scotland in 2019 accounted for 16 per cent of tonnage (62 thousand tonnes) and 34 per cent by value (£196 million)[21]

3.1.2 Fragmentation

- At present within Europe and the NPA region, there is fragmentation of policy approaches to waste and "end of life" fishing gear[22]. This also applies within regions within countries
- For example, different rules apply to waste and "end of life" fishing gear in different ports and counties within Ireland. Six commercial ports are governed by Department of Agriculture, Food and the Marine (DAFM), with smaller ports and harbours governed by local authorities or county councils. There are different approaches to waste management plans, all often reporting waste statistics to different departments leading to further fragmentation (Galway)

[20] An initial pilot workshop was organised in Ålesund on 25th April 2019 to test the content and process, and the lessons learnt were brought into the design of 2nd Ålesund workshop and Galway workshop https://cfsd.org.uk/projects/bce/workshops/Ålesund-local-innovation-systems/

[21] https://www.gov.scot/publications/scottish-sea-fisheries-statistics-2019/pages/3/

[22] https://cfsd.org.uk/wp-content/uploads/2017/11/Circular-Ocean-Port-Reports-FINAL_FINAL_ALL.compressed.pdf

3.1.3 Legislation

- There is a need for clear communication at a member state level of the requirements and deadlines for stakeholders in relation to the forthcoming EC's EPR legislation covering fishing gear
- During the Galway workshop, a Harbour Master in Ireland (a DAFM employee) was unaware of key aspects of the forthcoming EPR legislation. This included importantly timelines for the development and implementation of both EPR and Port Reception Facility (PRF) legislation, which perhaps indicated that important information was not being effectively disseminated from central government (Galway)
- There was also a lack of awareness over the status of EPR legislative development for fishing gear in Norway amongst the fishing gear manufacturers/assemblers that were present at the workshop. There had been previous discussions that Norway was going to set up its own EPR system, but then there was some debate over whether they would use other public policy instruments related to recycling and reuse of fishing gear. From discussions with a Scandinavian expert outside the workshop, there was an indication that Norway may follow the EC's EPR strategy (Ålesund)

3.1.4 Definitions

- The definition of waste in the context of fishing gear and EPR was identified as an issue. A number of attendees indicated that waste licensing requirements and classification needed to be reviewed, with potential derogations being required for handling, transporting and processing material that has been classified as waste to the point where it can re-enter a supply chain (Galway)
- It was suggested that Irish Environmental Protection Agency (EPA) will potentially need to issue an "end of waste criteria" for fishing gear - adding complexity to requirements in establishing a recycling facility[23] (Galway)

3.1.5 Standards

- In 2021, new standards development started within CEN TC 466 covering the circular business models, and the recyclability and circular design of fishing gear. This was mandated by the EC in the Circular Economy Action Plan 1.0 in 2015[24] and was delivered by DG MARE to CEN to start the development process in Q4 2020

[23] https://www.epa.ie/waste/wastereg/art28/
[24] https://eur-lex.europa.eu/resource.html?uri=cellar:8a8ef5e8-99a0-11e5-b3b7-01aa75ed71a1.0012.02/DOC_1&format=PDF

- At present there is no evidence of any fishing gear manufacturers/assemblers implementing ecodesign (and circular design within it) within design and development of fishing gear (see Circular Design)

3.1.6 Awareness

- It appeared from the workshops that there is more awareness of waste and "end of life" fishing gear issues in Ireland compared to Norway. This was perhaps driven by an initial stakeholder meeting organised by Bord Iascaigh Mhar (BIM) in Cork, Ireland in June 2019[25] and proactive engagement in EC EPR policy dialogues in Brussels by a number of Irish stakeholders (Galway)
- In Norway awareness of EPR development was not evident in the workshop. Perhaps awareness is higher within more closed "industry networks" due to the relatively large size and importance of the Norwegian fishing industry (compared to the sector in Ireland) (Ålesund)

3.1.7 Information

- There will need to be the development and communication of simple checklists for key stakeholders advising them of what they will need to do in relation to the requirements of forthcoming EPR legislation for fishing gear in each member state (and other countries that also might implement EPR schemes outside the EC system)
- Specifically, it was highlighted that there will also need to be a listing of authorised recyclers in each member state in relation to the requirements of the forthcoming EC EPR legislation for fishing gear

3.1.8 Data

- At the time of the workshop there was a lack of data on the volume of waste and "end of life" fishing gear arising at Irish ports. This is likely to be equally true of most ports throughout the NPA region and Europe as there has been no need or requirement to collect such data in the past (Galway)
- Setting up systems to collect data from different stakeholders will be a challenge in relation the EC requirements to determine fishing gear placed on the market and waste fishing gear (containing plastic) collected in the member states.

[25] https://www.ouroceanwealth.ie/news/circular-economy-reduce-reuse-repurposing-fishing-gear-focus-bim-workshop-cork

3.1.9 Tracking

- A number of fishing organisations and fishing gear manufacturers/assembelers appear to be supportive of tagging fishing gear to track the origin of waste and "end of life" fishing gear. A case study on this would be welcomed. For example, Blue Ocean Gear has developed smart buoy and gear tracking technology[26] that identifies and locates "ghost gear" in real time

3.1.10 Organisation

- There are no national fishing gear producer/assembler industry organisations in Ireland and other member states, and this also applies to the Norway (and the UK)
- To help facilitate and overcome challenges associated with the upcoming EPR legislation, fishing gear producers/assemblers should establish national bodies in European member states (and outside) to represent their knowledge and experience. Perhaps Eurocord,[27] as the European trade association for manufacturers of agriculture nets, fishing nets, etc, has a role in supporting national and regional development specifically related to fishing nets and gear more generally

3.1.11 Dialogue, engagement and collaboration

- It is essential that all relevant stakeholders are engaged in the discussion over waste and "end of life" fishing gear if EPR schemes in member states are to be effectively implemented. For example, discussion at the Galway workshop indicated that the Irish fishing sector claimed to be largely on board with tackling the issues of marine litter, with more than 1,000 vessels signed up to the "Fishing for Litter" scheme[28] (Galway)
- Previous research and feedback from both workshops highlighted that there is usually significant dialogue between fishing gear manufacturers/assemblers and fishers (e.g. customers) in relation to the design and development of fishing gear
- This means that often highly customised fishing gear solutions are produced based on needs and wants of fishers[29]
- In Ålesund, an interesting model for potential long-term value chain collaboration appears to have been established related to waste and "end of life" fishing gear with companies already

[26] https://www.blueoceangear.com
[27] https://www.eurocord.com/
[28] https://fishingforlitter.org/
[29] https://cfsd.org.uk/wp-content/uploads/2020/07/FINAL-V2-BCE-MASTER-CREATING-BUSINESS-OPPORTUNITIES-FROM-WASTE-FISHING-NETS-JULY-2020.pdf

in dialogue with each other: Viking (recycler); Norplast (pellets); Aeron (injection moulder); and Selstad (fishing gear manufacturer/assembler) (Ålesund)

3.1.12 Co-operation

- There is a need for co-operation amongst different stakeholders to tackle recycling and innovation related to waste and "end of life" fishing gear. To enable such co-operation, experienced connectors or mediators with good people management skills, who have credibility amongst fishing and business stakeholders related to waste and "end of life" gear, will need to be identified and recruited in countries and regions to catalyse activities
- For example, in a location in Ireland, one large fishing co-operative and one large fishing net assembler are physically located next to each other. That would be potentially an ideal location for a recycling facility and/or an innovation lab (see later discussion on BCE Lab©). However, this would also require good co-operation between all relevant stakeholders: fishing co-operative; a DAFM-controlled harbour serving international fishing vessels; local members of the Irish fleet; other fishing net manufacturers/assemblers; and existing fishing net dismantlers e.g. fishers, that might have large stockpiles of shredded and mixed nets, potentially with licensing and waste handling permits (Galway)

3.1.13 New roles

- Fishing organisations and enforcement agencies could be encouraged to play a more proactive role in the evolving discussion related to EPR for fishing gear
- Traditionally, fishing organisations have strived to show they work specifically for their members' interests and tend not to get involved in initiatives outside that remit. That could be perceived to be inward looking and detrimental to tackling the challenges associated with recycling fishing gear and developing national recycling infrastructure in preparation for the forthcoming EPR regulations (Galway)

3.1.14 Recycling

- At present there is little specialist recycling and reverse logistics infrastructure for waste and "end of life" fishing gear in Europe and the NPA region, with the most prominent players being Plastix Global (mechanical recycling), Aquafil (chemical recycling), and Nofir[30] (reverse logistics); although there are other companies now entering the market. For example, Containerservice Ottersøy AS,[31] a large waste management company in Norway, launched

[30] https://nofir.no/en/

[31] https://www.facebook.com/matmortua

a plastic recycling company called Noprec[32] which appears to have developed a process to bring down the cost/price of pellets from waste fishing gear polymers. This has made the pellets more price competitive compared to virgin polymers, and Noprec is now selling pellets to various end users (Ålesund)

- Aquafil has a chemical recycling plant in Slovenia. It utilises a depolymerisation process that breaks down nylon to its original chemical building blocks known as monomers, which can be used to make new nylon that is virtually identical to the virgin feedstock that had come from fossil fuels. In May 2021, Plastics Europe predicted a significant increase in planned overall chemical recycling investment: from 2.6 billion Euros in 2025 to 7.2 billion Euros in 2030. But, to further accelerate investments there is a need for a harmonised and strong policy and regulatory framework.[33] In addition, the overall environmental impact of chemical recycling needs to be factored into discussions
- Both workshops highlighted a need for discussion over the amount of public/private funding that is/will be needed to build the mechanical and chemical recycling, and reverse logistics infrastructure for fishing gear in Norway and Ireland (and other EC member states) to support implementation of the forthcoming EPR legislation

3.1.15 Contamination

- There is an ongoing problem of fishing gear being contaminated by biotic materials and aquaculture gear by anti-foulant coatings, which demonstrates that there is a need to develop new solutions and new technologies for decontaminating fishing gear. Perhaps relevant research and innovation institutions might develop funding calls targeted at SMEs and universities to develop such solutions
- Various issues associated with contamination of fishing gear were highlighted. It would be useful to develop a typology of levels of degradation and contamination of fishing gear to support stakeholder's decision-making in relation to potential reuse and recycling of gear e.g. from unusable to potentially usable
- It is understood that Plastix Global claims to have developed a new process to accept contaminated polymers for its mechanical recycling process. It understood that this includes even those polymers that are contaminated with sand

[32] https://noprec.no/

[33] https://www.plasticseurope.org/en/newsroom/press-releases/european-plastics-manufacturers-plan-over-7-billion-euros-investment-chemical-recycling

- The Ålesund workshop highlighted that Trifol[34] in Norway had developed a thermochemical recycling process with UK partners that is understood to be able to recycle fishing nets contaminated with sand and biofouling, even if there are relatively large particle sizes. There appeared to be a potential desire to lab test fishing gear for the suitability for chemical conversion and indications that various types of polymers could be handled with the exception of nylon (Ålesund)

3.1.16 Materials banks

- Stocks of fishing gear are being held by fishing gear producers/assemblers for a variety of reasons including seasonal use and also re-sale when the market price for recycled polymers is "right". The latter issue was also highlighted in the Stevenson Harbour case study (see Annex 2)
- However, there are also indications of the stockpiling of waste and "end of life" fishing gear at harbours, as there is often a lack of cost-effective waste management options

3.1.17 Markets

- The workshops discussed the need to stimulate market development for products that reuse and upcycle waste and "end of life" fishing gear, and/or utilise pellets and filaments from recycled polymers. There may be business-to-consumer (B2C) and business-to-business (B2B) and, public procurement opportunities as local government explores green, and more specifically, circular procurement
- Could local government public procurement teams, retailers and garden centres in ports, harbour and fishing communities, and surrounding communities work together to develop market pull for products derived from waste and "end of life" fishing gear?
- At present the number of commercial products utilising waste or "end of life" fishing gear and/or recycled polymers is limited;[35] although there are indications that there is an increasingly specification of second life fibres from fishing gear in clothing, carpets, etc[36]

3.1.18 Supply chains

- There is a global supply chain for fishing gear, with the polymers often being produced in and procured from India, China and other countries in South-East Asia

[34] https://www.trifol.ie/technology

[35] https://cfsd.org.uk/wp-content/uploads/2016/10/Circular-Ocean_Research_Products_FINAL_23-04-18.compressed.pdf

[36] https://www.econyl.com/

- Fishing gear producers/assemblers will need to work with polymer and other materials suppliers to integrate circular design considerations into material and component specifications
- Transparency and traceability of materials will become a growing issue

3.1.19 Circular Design

- Standards are in development related to the circular design of fishing gear through CEN Technical Committee TC 466. [37] Circular design can be viewed as an element of ecodesign, where there are two existing international standards (14006:2020 [38] and IEC62430:2019 [39]). As product-related environmental requirements are new, ecodesign (and circular design within it) does not appear to be currently practised by fishing gear producers/assemblers in the gear design and development process. From initial discussion with a gear technologist, CAD tools appear to be used for gear design but the CAD tools do not appear to include environmental modules[40]
- Fishing gear is not presently designed for modularity to enable upgradability, repair or disassembly. As a result, it is costly to disassemble fishing nets due to the time involved in manual dismantling processes. A potential solution is for fishing gear to be "designed for disassembly" to reduce costs and ease the separation of materials (as needed) at the end of (each) life of the fishing gear. Such a design strategy would support the culture of product life extension through repair that already exists amongst fishers

3.2 BCE Lab © - Innovation Lab Related to Waste Fishing Gear

3.2.1 BCE Lab©: Background

3.2.1.1 Introduction

Within both stakeholder workshops, a series of presentations was completed, followed by a series of interactive work group discussions.[41] Following the presentations covering legislation, trends and issues, the concept of an innovation lab was presented. The aim of BCE Lab© is to develop and commercialise new products (and possibly new circular business models) derived from/related to

[37] https://standards.iteh.ai/catalog/tc/cen/8972c136-24ea-43a1-be18-8f0769600aee/cen-tc-466
[38] https://www.iso.org/standard/72644.html
[39] https://www.iso.org/standard/79064.html
[40] https://cfsd.org.uk/wp-content/uploads/2020/07/FINAL-V2-BCE-MASTER-CREATING-BUSINESS-OPPORTUNITIES-FROM-WASTE-FISHING-NETS-JULY-2020.pdf
[41] https://cfsd.org.uk/projects/bce/workshops/

waste and “end of life” fishing gear. A BCE Lab© might be located in Ålesund[42], Galway or elsewhere in the NPA region.

The presentation on the BCE Lab© concept was embedded in a broader discussion on

- Local innovation ecosystems and fishing community/networks in Ålesund or Galway
- Interaction between stakeholders in each of the regions
- Business opportunities related to converting waste fishing gear (into products and start-ups) in the region

Following the BCE Lab© presentation, working groups were organised to discuss the concept and practicalities of establishing a BCE Lab© in each location. This included an exercise to discuss the business model of a BCE Lab© using Business Model Canvas (BMC)[43] - which was used to frame the discussion. This then led to discussions over the key issues associated with the development of a business model for BCE Lab© and the potential strengths and weaknesses of the concept.

Below is an overview of the concept of a BCE Lab©.

3.2.1.2 Description

A BCE Lab© is a concept for an innovation lab or hub aimed at the development of new products (and possibly new circular business models) derived from/related to waste and “end of life” fishing gear. BCE Lab© builds on the concept of COINLab originally developed in 2018 with the Circular Ocean project.[44] A BCE Lab© incorporates four modules: Design Lab; Processing Lab; Manufacturing Lab; and Startup Lab.

A BCE Lab© should be viewed as a place to bring together local fishing communities - that have access to waste and “end of life” fishing gear - with innovators and entrepreneurs to develop new solutions. The overall aim of a BCE Lab© is to drive the design and development and potential commercialisation of new products (and possibly new circular business models) that utilise waste

[42] An initial pilot workshop was organised in Ålesund on 25th April 2019 to test the content and process, and the lessons learnt were brought into the design of 2nd Ålesund workshop and Galway workshop https://cfsd.org.uk/projects/bce/workshops/Ålesund-local-innovation-systems/
[43] https://en.wikipedia.org/wiki/Business_Model_Canvas
[44] https://cfsd.org.uk/wp-content/uploads/2018/09/COINLabs-final.pdf

and “end of life” fishing gear as the source of raw materials, or through the reuse of fishing gear into new applications.

The focus of a BCE Lab© is on value creation, collaboration and knowledge sharing rather than waste management.

BCE Lab© uses the term “Lab” in the broadest sense of depicting an *innovation environment* rather than specifically a technical laboratory related to solutions to waste and “end of life” fishing gear. The “Lab” is an entity concerned with interdisciplinary collaboration between fishers, entrepreneurs, technical experts, designers, micro and small businesses, social enterprises and the wider local or regional community; and, where appropriate, academia and research institutions.

In some circumstances, assistance (knowledge and time) might be seconded to a BCE Lab© by central or local government, or from specialist departments e.g. circular economy, manufacturing, etc, of innovative and/or medium sized or large businesses. To take forward the development of a BCE Lab© funding or grants, or “in kind” assistance might also be accessed from the public sector e.g. local and regional authorities, companies, charities or foundations.

3.2.1.3 “Value added”

The concept of a BCE Lab© spans the entire value chain from the initial collection and processing of waste and “end of life” fishing gear to product development and company start-up.

Who might be suited to start up and/or run a BCE Lab©? A leader – from the community or business - who, a) has experience of working with fishers, b) has experience in gaining funding and collaboration with external parties, c) gets on well with people and can bring fishers on-side early, and build and maintain a good working relationship with all stakeholders, d) is enthusiastic about the community building and has experience of managing a business or social enterprise start-up.

A BCE Lab© would aim to provide support to relevant organisations in range of areas from idea generation to company set-up, to production and sales, etc through advice on funding, collaboration, networking and marketing. Participants in a BCE Lab© could be a pre-start-ups, start-ups, existing micro or small business, social enterprises, and/or collaborative networks of entrepreneurs. These might range from: a) creative and designed-oriented individuals to those with, b) direct hands on experience of processing waste fishing gear and/or able to oversee such work, to those who have c) knowledge of extruders and other equipment, including, potentially, 3D printers - and/or those

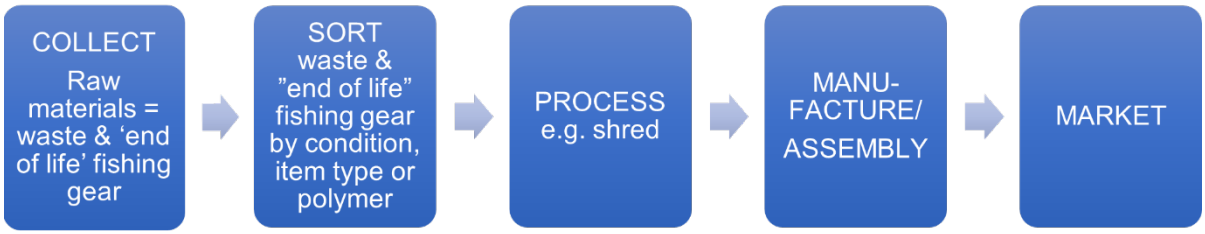
who know how outsource manufacturing/production to third parties, and d) those with marketing and sales experience.

The focus of a BCE Lab© is on the delivery of *value* – rather than on tackling waste streams – through four modules - Design Lab, Processing Lab, Production Lab and Startup Lab.

The BCE Lab© process would start with recovery and collection of waste and "end of life" fishing gear and then move to reprocessing including cleaning, washing and drying before producing pellets or filament, or re-using nets or sections of fishing gear. This would be coupled with the development of concepts then prototypes and final products that would be produced in jobs or batches and then sold and distributed locally, nationally or internationally.

The BCE Lab© value chain model is illustrated in the diagram below, where each different type of polymer (e.g. polyamide [nylon], polypropylene, polyethylene) will have a separate route of collection, reprocessing, manufacturing and final product development. Potential reprocessing processes may include several different technologies and methods from water-based cleaning and shredding, to advanced chemical reprocessing.

Figure 1: BCE Lab© Value Chain Model



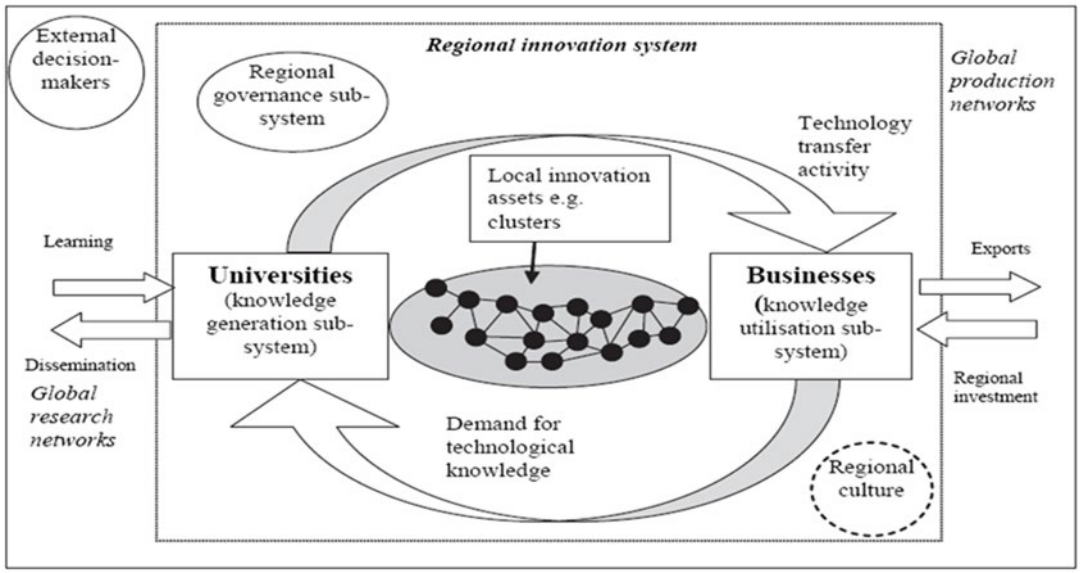
In considering a BCE Lab© concept, it is also useful to review the lessons learnt in Sotenäs Marine Recycling Centre (SMRC) (Annex 1) and Stevenson Harbour (SHA) (Annex 2).

3.2.1.4 Part of local innovation ecosystems

A BCE Lab© should aim to work within the existing local innovation ecosystem in the urban and rural areas where ports and harbours are located. A BCE Lab© could be established as a) standalone entity or b) as a networked model where the four modules - Design Lab, Processing Lab, Production Lab or Startup Lab - might be located in different places in area surrounding the port or harbour, or

in the wider region. Where practical and relevant, a BCE Lab© should look to partner and/or collaborate with existing stakeholders in local innovation ecosystem – see Figure 2. [45]

Figure 2: Regional Innovation System



3.2.1.5 Partner options

A BCE Lab© is a flexible concept

- The four modules might be sited in a dedicated/shared location e.g. suitable vacant premises/or those with under-utilised space within harbours or ports
- The four modules might be dispersed geographically in a town, city or region (in a spoke and wheel arrangement) with central point to co-ordinate inputs and outputs.
- There might be hybrid models where relevant existing stakeholders are already engaged in activities related to the modules
- There might be a blended model with some elements of a BCE Lab© completed online and some physically

Various local stakeholders might act as partners in the development and organisation of a BCE Lab© - overall – or with the specific modules. Some of those organisations might include

- Universities, research Institutions, technical schools

[45] Source: Őzgür Őnday (2016), National and Regional Innovation Systems, Industrial Policies and their Impacts on Firm Innovation Strategies and Performance - Economic Role of Knowledge, International Journal of Contemporary Applied Sciences Vol. 3, No. 2, February 2016 (ISSN: 2308-1365)

- Corporate venture teams (funding, intellectual input, knowledge of markets), governmental organisations (local, national, international), etc
- Community workshops and/or grassroots innovators (e.g. Makerspaces, Hackspaces, Fab Labs)[46]
- Social businesses

3.2.2 BCE Lab©: Integrated concept

A BCE Lab© process might start with an idea for a product that is brought to or arises in a Design Lab before a start-up has been established. An idea might emerge from an existing company that might be operating in a Startup Lab or outside the BCE Lab©. From the idea, a concept will then need to be developed followed by a prototype in a Manufacturing Lab using materials from a Processing Lab. Depending on different factors, the use of the labs or modules may differ. For example, a company in the Startup Lab might produce a product concept skipping the Design Lab and go directly into the Processing and Manufacturing Labs. Where external partners - companies, social enterprises or entrepreneurs – are involved, the engagement might be in just one, or more, of the Labs.

A BCE Lab© includes four modules, as highlighted above. They are:

- Design Lab: ideation, iteration and/or prototyping of solutions for any stage of the value chain for waste and “end of life” fishing gear
- Processing Lab: processing of waste and “end of life” fishing gear (e.g. by washing, drying, depolymerisation, etc) to provide “‘clean” materials e.g. recycled pellets, filament or fibre to feed into manufacturers and B2B supply chains outside the BCE Lab© and/or into the Manufacturing Lab
- Manufacturing Lab: manufacturing and/or assembly operations that utilise waste and “end of life” fishing gear to produce products targeted at B2C, B2B or B2G (business-to-government) market. This might through from injection moulding or simpler assembly operations reusing fishing gear into new applications.
- Startup Lab: an incubator or hub for start-ups and attracting existing micro SMEs to re-locate

Below is a more detailed description of each of the four modules of a BCE Lab©.

[46] https://cfsd.org.uk/wp-content/uploads/2018/09/Community_Workshops-final.pdf

3.2.2.1 Design Lab

Purpose

- A Design Lab is concerned with the creation of ideas, concepts, prototyping and testing of products (and potentially new circular business models) that are derived from/relate to waste or "end of life" fishing gear. The main output of the Design Lab is final product prototypes that are ready to move into Manufacturing Lab or outside production and/or assembly operations depending on the scale for activity
- The Design Lab might have a strong focus on open innovation and collaboration to engage with external stakeholders

Open innovation

- A Design Lab might be established as a collaborative, explorative and engaging "Living Lab" [47] that is based on participation by different stakeholders in local communities e.g. NGOs, citizens, beach cleaners, divers, fishers, schools, grassroot innovators, fishing net manufacturers/assemblers, university students and researchers as well as local government, social enterprises, large companies, SMEs and members of local start-up networks. Engagement could be started through connecting with local stakeholders and/or business networks e.g. through chambers of commerce or business breakfast networks
- Dependant on the mission of a BCE Lab© - and a Design Lab within a BCE Lab© - it might run as part of an "open innovation" [48] [49] environment characterised by interaction and sharing of ideas, know-how, tools and technology amongst different users, sponsors and collaborators. The aim might be to create and propagate, ideas and concepts for relevant stakeholders to develop further e.g. playing a catalytic role in or outside the BCE Lab©
- However, if the focus of a BCE Lab© aims to be on the commercialisation of innovative ideas to create income and employment in local communities - unless an open innovation model is implemented perhaps aligned to a not-for-profit, charitable or social enterprise status - there should be an ongoing documentation of solutions and knowledge produced with processes established to protect IPR and/or commercial, confidentiality issues via NDAs, etc

[47] https://en.wikipedia.org/wiki/Living_lab
[48] https://en.wikipedia.org/wiki/Open_innovation
[49] https://hbr.org/2020/06/why-now-is-the-time-for-open-innovation

Collaborative platform

- As indicated above, a Design Lab should aim to engage with other stakeholders and user groups in the local innovation system
- A Design Lab could facilitate or host pop-up shops for participants in nearby areas of high footfall close to the location of the BCE Lab© to gain potential user or customer feedback in relation to new concepts and prototypes
- Incorporating industrial design input in a Design Lab might heighten the perceived value of the products from products from waste and "end of life" fishing gear compared to hobbyist style experiments made and designed by volunteers
- A Design Lab could involve local crafts people and designers in the design and development phase of products e.g. to produce customised designs, models and prototypes for all or some of the envisaged products

Shared facility

- A Design Lab might be a shared facility that incorporates a range of activities to move ideas to prototypes
- A location close to a port or harbour area would make access to waste and "end of life" fishing gear easier. Storage of fishing gear prior to processing may be a logistical challenge with often limited space in port or harbour areas [50]
- A key challenge for a Design Lab will be how to gain momentum and a develop a critical mass of participants, users and activities to sustain an active, dynamic, creative environment
- A collaborative approach might be developed within a Design Lab as part of an existing facility and innovation environment (at least initially). A Design Lab, for example, might be aligned to an existing Makerspace, a FabLab or a university or technical college with an already established user-base that has physical facilities, tools and machines[51]

[50] Circular Ocean Port Related Feasibility Studies related to the collection and recycling of waste fishing nets and ropes in Greenland, Ireland, Norway and Scotland https://cfsd.org.uk/wp-content/uploads/2017/11/Circular-Ocean-Port-Reports-FINAL_FINAL_ALL.compressed.pdf

[51] https://cfsd.org.uk/wp-content/uploads/2018/09/Community_Workshops-final.pdf

Activities

- As indicated above, the key focus of a Design Lab will be to facilitate experimentation aimed at producing early stage prototypes of products/services derived from waste and "end of life" fishing gear and to facilitate R&D
- A Design Lab should aim to generate knowledge, designs and new solutions related to waste and "end of life" fishing gear in symbiosis with innovative people, groups and organisations based in the local area and through online communities
- A Design Lab should be designed as a creative and relaxed, "fun" environment that includes a broad mix of different physical and virtual events targeted at different stakeholders. This would allow Design Lab users to interact more cohesively even if they are a mix of permanent staff, temporary project workers or other stakeholders working physically, virtually or in blended manner. Café facilities could be established to facilitate interaction between local stakeholders including entrepreneurs, fishermen, beach cleaners and schools
- A Design Lab could allow "external guests" - volunteers, visiting scholars and entrepreneurs - to participate in talks and social events and utilise hot desking if required. A residency programme would allow for guests to stay for longer than a day or a night
- A Design Lab might organise a range of events using different formats. This might include:
  - Hackathons[52] or Design Sprints with the focus on developing solutions to waste and "end of life" fishing gear e.g. #Net_Hack_Challenge [53] and #Chem_Hack[54]
  - Start-up Weekends with the focus on building a business
  - PechaKucha[55] style inspiration presentations and networking events themed on topics that help BCE Lab© participants with their businesses and project(s)

3.2.2.2 Processing Lab

Purpose

- A Processing Lab is a space allocated for the processing of waste and "end of life" fishing gear. Processing includes dismantling and separating different fishing gear components and then washing and drying those polymers to produce pellets and filament that can be used in

[52] A hackathon is typically an event in which a number of people meet to engage in moving a project on at speed, and can include collaborative creativity, concept development etc

[53] https://cfsd.org.uk/projects/circular-ocean/nhc/

[54] https://cfsd.org.uk/wp-content/uploads/2016/10/CircularOcean_ChemHack_FINAL.compressed.pdf

[55] https://www.pechakucha.com/about

injection moulders and extruders for 3D printers in the Manufacturing Lab. Another element of the Processing Lab is the preparation of waste and “end of life” fishing gear prior to cutting them into sections for reuse directly in the assembly of products e.g. bags, bracelets, etc in the Manufacturing Lab

- The different activities of a Processing Lab may require shredders (or access to local shredders) and other specialised equipment, storage space, containers and vehicles for the collection of waste and “end of life” fishing gear
- Ideally, a Processing Lab should be located on or near a port or harbour, close to where waste and “end of life” fishing gear can be sourced from fishers. This will minimise the costs of transportation. More importantly, proximity will provide the best conditions for cleaning fishing gear while they are still wet and before organic compounds in them dry and make cleaning a much more difficult task
- If polymers from waste and “end of life” fishing nets are to be converted into pellets for injection moulding or filaments for 3D printing, they should also be dried, because polymers absorb water that will be released under heat and cause problems in pellet, filament and fibre production process

Manual labour

- A Processing Lab will require manual labour for collection, sorting, shredding, etc; and the number of people employed will be dependent on the scale of activities and available budgets
- Manual staff might be employed or contracted through co-operation with social services, community reuse schemes, and/or other related projects, and charities linked to mental health and the long-term unemployed schemes that aim to get people back into work or society

Social enterprise

- If a “wheel and spoke” model is decided upon for the development of a BCE Lab©, a Processing Lab might be run as a social enterprise. Other modules might have different structures. This might make it easier to access the financing needed to invest in machinery and other physical facilities. As mentioned above, collaboration with social services in the local authority might identify opportunities to employ people with special needs, learning difficulties and social problems in relation to collection, cleaning, separation, shredding, etc
- Harbour and/or port operators might have facilities and space that are under-utilised and might be interested in setting up a collaboration or formal partnership. Existing businesses

with experience in collection, sorting, cleaning, shredding, etc based in the area surrounding the port or harbour area might also be approached to re-locate or set up new facilities in the Processing Lab

3.2.2.3 Manufacturing Lab

Purpose

- The Manufacturing Lab is a facility for the manufacture and/or assembly of products from waste and “end of life” fishing gear that are produced using pellets, fibres and/or filaments created from processing of polymers from the Processing Lab. In addition, products may be assembled from sections of waste or “end of life” fishing gear and repurposed into, for example, crafts, accessories and garden products. Social businesses or community reuse organisations with access to manual labour and/or local volunteers might be useful partners for products involving assembly
- The types of equipment needed for the Manufacturing Lab will be dependent on the types of products that a BCE Lab© will produce. That, in turn, will depend on the prototypes that will emerge from the Design Lab, the type of fishing gear collected, and the polymers processed in the Processing Lab, and the budgets available. A BCE Lab© might partner with companies based in local innovation systems to share, rent or lease equipment based on needs and requirements of a Manufacturing Lab.

Production equipment

- A Manufacturing Lab will typically require specialist first or second life production equipment e.g. injection moulder, extruder and 3D printers. Therefore, finance is likely to be required in most cases to establish manufacturing unless local business can donate production equipment. As with a Processing Lab, collaboration with companies and other stakeholders within local innovation systems in urban or rural areas surrounding port, harbours and fishing communities should be considered
- Injection moulding equipment is ideal for producing a small range of products that can be produced in large quantities. Extruders for producing 3D printer filaments allow for a greater variety of product types but perhaps on a smaller scale. The types of relevant production equipment that are used in the local innovation system might be mapped and, based on that information, decisions might be made on what machinery should be bought, leased or rented, or potentially used on shared basis e.g. through identifying underutilised machines in local businesses

Product categories

- Initially, “plug and play” local products, e.g. frisbees, etc could be produced for tourists and others. Such an approach would enable a Manufacturing Lab to get up and running at reduced financial risk through using efficient production runs for job lots or small batches
- Another approach might be to focus on a narrow series of products with a simple and proven production and/or assembly method(s) that should be relatively simple to execute and replicate. Products could include door handles, skateboards, frisbees, small surfboards, etc that have shown proof of concept around the world.[56] Replication locally or regionally or across the NPA region could happen via sharing lessons via an online platform that is made accessible via selected or all BCE Labs©. This might include information on specialised machine specifications that match the needed production set-up of any Manufacturing Lab. A similar example is found in the Precious Plastic project, where blueprints for building “your own plastic reusing machine” are shared online.[57] For example, Project Net:Worth produced a prototype door handle using polymers from waste fishing gear[58] by following the Precious Plastics model and adapting machinery
- The Precious Plastic project might act as a useful resource for lessons learnt in relation to the local development and production of products from polymers derived from waste fishing gear[59]
- As highlighted earlier, another development route could be to explore the possibilities of utilising the manufacturing capacity of companies in the local innovation system through, for example, identifying plastics moulders and producers experienced in working with recycled polymers, who may have spare capacity or interested in diversifying into new product areas

3.2.2.4 StartUp Lab

Purpose

- A Startup Lab should be considered as a location within the BCE Lab© for a business incubator and/or accelerator programme focused on start-ups and existing micro SMEs commercialising products, services and business models derived from waste and “end of life” fishing gear

[56] https://cfsd.org.uk/wp-content/uploads/2016/10/Circular-Ocean_Research_Products_FINAL_23-04-18.compressed.pdf
[57] https://preciousplastic.com/
[58] http://www.clairepotterdesign.com/theecospot/2018/03/10/project-net%C2%B7worth-the-final-handle/
[59] https://cfsd.org.uk/wp-content/uploads/2020/07/PP_Report_Final_2020-07-04.pdf

- A Startup Lab would aim to incubate start-ups for, for example, a fixed period e.g. 6 – 12 months. Start-ups which join a Startup Lab programme will be able to access business support, information and skills sited either at the Startup Lab or online. Access might be based on a subscription model and/or through some form of subsidised or free programme sponsored or funded by the private or public sector, or charities or foundations
- Advisors based at the Startup Lab would provide knowledge and expertise related to strategy, marketing, product development, financial, legal, intellectual property rights (IPR) and funding (e.g. crowdfunding or grant fundraising). Other key start-up disciplines could also be contracted into a Startup Lab
- A Startup Lab could connect participating entrepreneurs with local - and further afield - industries and suppliers through running matchmaking activities to find co-founders, directors, team members, investors, advisors, mentors and other key individuals in the local start-up ecosystem or from further afield
- Depending on the business model of the BCE Lab©, a Startup Lab might include free or low cost access to production facilities and tools in the Manufacturing and Processing Labs that could be shared and utilised by a Design Lab for prototyping

Shared sales and distribution

- A Startup Lab might offer its participants access to a shared platform for collaboration in relation to sales and distribution. It could be in the form of a built-in factory-style shop linked to a Manufacturing Lab and/or full online shop facilities. Also, a collaborative dealer network could be set up to sell products (derived from waste and “end of life” fishing gear) into design stores, apparel stores, outdoor gear stores locally, regionally, nationally or internationally
- A brand could be produced acting as a “quality stamp” for products made according to the overall BCE Lab© model

3.2.3 BCE Lab©: Ålesund and Galway

The concept of a BCE Lab© was presented and discussed in different working groups at both the Ålesund and Galway workshops using a structured approach including the Business Model Canvas (BMC)[60]. Below is the feedback from participants from each workshop by each region classified

[60] https://www.strategyzer.com/canvas/business-model-canvas

under a series of sub-headings. More detailed information was provided by delegates at the Galway workshop due to larger number of participants and workshop process improvement that resulted from lessons learnt from the Ålesund workshop.

- General discussion
- Business model
- Key issues
- Strengths
- Weaknesses

3.2.3.1 General discussion

3.2.3.1.1 Ålesund

Participants emphasised the following points:

- Think “industry”, not hobby or small-scale artisan crafts i.e. meet the challenges of new product development and production through a commercial end-to-end process. In other words, focus on a business-led strategy - not a cottage industry approach
- It will be essential to access reliable volumes of waste and “end of life” fishing gear to produce pellets and filament from recycled polymers
- A first step will be the identification of sources of funding for each module of a BCE Lab©
- There is a need to set up mechanisms early to capture knowledge arising from the development of a BCE Lab© alongside enabling networking and sharing of information. Stakeholder meetings using structured approaches was thought to be a good way to start discussions over tackling waste and “end of life” fishing gear and setting up a potential BCE Lab©. A participant stated, “Workshops like this are good for creating networks of like-minded individuals and organisations and extending theoretical, and practical thinking on the subject. i.e. talking and brainstorming, can be beneficial”
- Specific stakeholders that might be engaged in development of a BCE Lab© are highlighted in Annex 3

3.2.3.1.2 Galway

Participants made a range of both general and specific comments in the working group discussions that related to the Galway or broader Irish context

- Fishing as a business must remain viable
- To engage fishers, here must be no cost to fishers

The feedback from the workshop reinforced issues related to fragmentation and lack of infrastructure

- There are difficulties and issues associated with the fragmentation and different approaches to tackling waste and "end of life" fishing gear[61] e.g. different local authorities in Ireland have their own ways of managing waste, meaning that joined up thinking will be required to support the development of a BCE Lab© in different ports, harbours and regions
- It was highlighted that facilities at ports and harbours for the processing of waste and "end of life" fishing gear are inadequate in Ireland. Any innovative value chain development would suffer from fragmentation within the current Irish system. There is a need to identify SMEs that are directly engaged in the recycling and reverse logistics, and recruit them into the value chain. Pilot projects need to be established covering issues from recycling and reverse logistics through to the development of new product platforms. This pilot project might be organised with or within, or in association with a BCE Lab©
- Participants also noted that any waste management activity related to fishing gear needs to take account of "The capability of any vessel involved in any waste gear scheme to be able to accommodate lost gear found at sea and return it to land"

Other points emerged particularly around engaging stakeholders

- A BCE Lab© would have to liaise with many organisations that exist in local areas or regions, including: a) Galway Harbour Company – NPWS; b) Ros an Mhil Fishery Harbour Centre; c) BIM; d) GFDA – Galway Cork; e) Galway County Council.

[61] https://cfsd.org.uk/wp-content/uploads/2017/11/Circular-Ocean-Port-Reports-FINAL_FINAL_ALL.compressed.pdf

- Other stakeholders that that might be engaged in a BCE Lab© include: waste contractors; P&O Maritime and Marine Institute vessels[62]; Atlantic Aquarium Galway; GMIT (Galway-Mayo Institute of Technology) and NUIG (National University of Ireland, Galway) – as resources for innovation/systems thinking; Galway Men's Sheds[63] (community workshops where men create, converse and connect, this might include former fishers); Tidy Towns; Irish EPA; and Forage (for access to youth and innovation). Other stakeholders that were identified in working group discussions are listed in Annex 4
- Local environmental groups and the general public involved in beach cleans might be important stakeholders to help identify, classify and sort waste fishing gear that might be used in a Processing Lab
- There is a lack of information for and communication with stakeholders related to waste and "end of life" fishing gear e.g. what to take and where. BCE© Lab could position itself as a hub to help with networking and information dissemination related to innovation and the management of waste and "end of life" fishing gear

Various questions emerged from working group discussions which included

- How is lost gear currently accounted for?
- How should the amount of waste and "end of life" fishing gear be quantified?
- What is the cost of monitoring? Who will pay for it? And how will this be funded?
- How to mobilise and connect stakeholders in relation waste and "end of life" fishing gear; for example, there appeared to be a need for communications between the harbour masters and BIM[64] in relation to the upcoming EPR requirements
- If there a momentum for change among the general public in relation to tackling the issue of ocean marine plastics and fishing gear, this could help to mobilise stakeholders

A potential strategy to develop a BCE Lab© might be to develop it as a research and knowledge exchange project led by a university targeting innovation grants from EC or Ireland. This would be equally true for other places that might consider the development of a BCE Lab©

[62] https://www.marine.ie/Home/site-area/infrastructure-facilities/research-vessels/operational-support-services-partner
[63] https://menssheds.ie/sheds/shantalla-mens-shed/
[64] BIM is the agency of the Irish state with responsibility for developing the Irish marine fishing and aquaculture industries https://bim.ie/

3.2.3.2 Business Model

3.2.3.2.1 Ålesund

The Business Model Canvas (BMC) was used as a template for discussion on a business model for a BCE Lab© in the Greater Ålesund area.

The workshop organisers clarified that the BCE Lab© concept is about industry collaboration and is not only focused on handcraft and artisan products. The overall aim of a BCE Lab© was to upscale ideas to commercialised products.

A range of comments emerged from the group discussions

- Growing business interest in sustainability was seen as an important factor to consider when developing the BCE Lab©. There was feedback by participants that they felt that concept of a BCE Lab© would be supported by the "conscious consumer" who has increasing aware of the problems associated with ocean marine plastics and fishing gear
- It was highlighted that a BCE Lab© (or a broader BCE Hub©) would require a well organised logistics system, and more clarity was required on waste processing and separation
- It was highlighted that examples of commercial products derived from waste and "end of life" fishing gear that were presented, missed discussion over the process for upscaling in relation to supply, quantity, certification and logistics
- There were some comments that the BMC might be adapted and could be very useful tool for the Startup Lab within a BCE Lab©

Specific comments covered the need for greater clarity over the following aspects of BCE Lab©

- What are aims and objectives of a BCE Lab©?
- Clarity over the scope of activities of a BCE Lab© e.g. process and separation would aim to be organised within a Processing Lab as part of an overall BCE Lab© but also might be outside a BCE Lab©
- What type of external relationships would a BCE Lab© need to establish? e.g. Who are the partners for logistics system?
- What is the BCE Lab© role vis a vis startups and upscaling?
- Where do upscaled companies move after they move through the startup phase in the Startup Lab e.g. to an established accelerator programme in Ålesund?

3.2.3.2.2 Galway

The participants discussed the business model for a BCE Lab© in the Greater Galway area using the BMC as a template to guide dialogue.

The discussion highlighted that the business model for the BCE Lab© would need to address the end-to-end issues of the circularity of fishing gear including a shredding of fishing gear, raw materials handling and storage, design including manufacture, products produced and symbiosis between different parties.

A range of specific elements of the BMC were then discussed.

Costs

Participants raised questions around costs for participating members in a BCE Lab©

- Would there be a membership fee or a fee for participating?
- Would royalties be paid to investors who would take ideas to market?
- Could suppliers also be involved via patronage and/or sponsorship?

Activities

Key activities that need to be considered included

- Would governments be involved, and if so in what capacity? e.g. could government agencies act as a key partner for supply?
- The sourcing of raw materials e.g. “ghost gear” at sea and “end of life” gear on land
- Logistics, marketing, branding and product development were seen as key activities
- Sales channels could include B2B, with revenue coming from raw material and finished products and intellectual property (IP) e.g. patents

Resources

- Key people resources that would need to be recruited or seconded include engineering, product development, sales and marketing

Value proposition

The prime value proposition was thought to relate to:

- Environmental sustainability
- Supply provenance

Products

Suggestions included using recycled materials from waste and "end of life" fishing gear for "fun" products and educational/playground infrastructures. Examples of commercial products derived from waste and "end of life" fishing gear can be found in a report produced in 2018[65]

3.2.3.3 Key issues

3.2.3.3.1 Ålesund

Key issues related to the development of a BCE Lab© concept in the Greater Ålesund area were:

- Adopting the right mindset: "Think industry" from the start
- Determining the availability of polymers from waste and "end of life" fishing gear
- Early consideration of the commercialisation challenges associated with new products made from polymers from waste and "end of life" fishing gear
- A BCE Lab© should broaden its network to bring in industry stakeholders
- "Keep Labs Local": to ensure that a BCE Lab© would support local economies and the environment e.g. avoid transporting waste and "end of life" gear thousands of miles for processing and production
- Funding for the development and then on-going operation of a BCE Lab© will likely to need a mix of government grants with targets attached (see Annex I) and other incomes streams from investors and/or participants e.g. percentage of sales, licences, space rental, etc
- A feasibility study needs to be undertaken and a detailed funding model needs to be produced

[65] https://cfsd.org.uk/wp-content/uploads/2016/10/Circular-Ocean_Research_Products_FINAL_23-04-18.compressed.pdf

- Demand for recycled products derived from waste and “end of life” fishing gear is likely to increase as
    - consumers become more aware of the waste fishing gear problem at sea
    - products incorporating waste and “end of life” fishing gear become more available on the market
    - there is increased awareness of EPR legislation for fishing gear
- The workshop process was viewed as a useful mechanism for networking e.g. the creation new contacts and reinforcement of existing contacts, and to extend practical experience and know-how related to the challenges and solutions to waste and “end of life” fishing gear

3.2.3.3.2 Galway

Key issues related to the development of a BCE Lab© concept in the Greater Galway were

- It was thought that some fishing nations have better resourced fishing institutes and associations than Ireland, and other countries are able to draw down on a broader and deeper range of support, including potential funding for the development of more innovative concepts
- A BCE Lab© or a broader BCE Hub© concept will require start-up funding to establish the processes in a Processing Lab e.g. for shredding, cleaning and drying. It is therefore essential to consult with industry and other partners about the concept and the processes that are required to make it happen. Key will be access to and handling of raw materials e.g. polymers from waste and “end of life” fishing gear
- Some participants at the workshop saw recycling fishing gear as a cottage industry creating artisan and handcrafted products. It was recognised that the BCE Lab© needs to be clearly presented as a serious business model. See lessons learnt in Annex 1
- Early stage buy-in from manufacturers will be critical
- A BCE Lab© could contribute to employment and rural redevelopment, which could result in societal benefits, which in turn could help gain funding
- Collaboration across and between all sectors involved in the use and production of fishing gear, as well as stakeholders in the local innovation system, should be encouraged to engage within a BCE Lab©. There needs to be a willingness among all sectors involved to engage and potentially open-up their facilities and potentially change their way of doing business. Forthcoming EPR legislation may force change, so it may be good to get ahead of the game

- Involving experts and practitioners – particularly fishers – with knowledge of issues related to waste and "end of life" fishing gear will be crucial to the development of a BCE Lab© (see Annexes 1 and 2)
- A BCE Lab© would require good co-ordination to provide a "one-stop shop" involving the fishing industry, business community and academia to enable the development of new solutions for waste and "end of life" fishing gear
- A pop-up approach to the development of a BCE Lab© could save initial setup costs and would allow for phased learning. A "pop-up innovation lab" is a different concept from a "pop office" but lessons could be learnt from that approach. "A pop-up office"[66] is a space used as a regular office which is temporary, and usually within a location that isn't deemed as traditional. For instance, a "pop-up innovation lab" or a basic "pop-up" BCE Lab© incorporating "pop-up office" could be established in a large shipping container, or the back of a coffee shop or anywhere with space, electricity and broadband (fixed line or 4G/5G)
- Other issues raised were the strength and safety of material, potential high production costs, logistics and risks involved with taking forward a leading-edge concept like a BCE Lab© - and that industry, regulatory and legal standards would have to be met which will add costs

3.2.3.4 Strengths

3.2.3.4.1 Ålesund

There was perceived to be a range of strengths associated with a) the BCE Lab© concept generically and b) specifically in relation to the development of a potential BCE Lab© based in the Greater Ålesund area.

- A good concept to foster economic activity via circularity
- Waste or "end of life" materials from waste fishing gear is potentially "less expensive than new material" but there might be higher costs associated with processing it
- Networking is very important: the workshop highlighted that organised processes to bring stakeholders together was very useful and attendees wanted more information on workshop processes used in the event
- Once a network was established in Ålesund, it would be an excellent resource for knowledge exchange

[66] https://www.bbc.com/worklife/article/20190719-pop-up-offices

- The workshop process was very good mechanism to help generate ideas related to the challenge of waste and “end of life” fishing gear[67]

In addition, a BCE Lab© concept was viewed as

- Well disciplined
- Very easy to follow
- Showing the potential benefit of co-operation

Important caveats were also mentioned

- Gaining initial funding to set up a BCE Lab© in Ålesund would be no guarantee of ongoing economic longevity of such an initiative
- The importance of logistics was highlighted in relation to waste processing
- It will be essential to involve people with key skills e.g. in marketing and product development

3.2.3.4.2 Galway

There was perceived to be a range of strengths associated with a) the BCE Lab© concept generically and b) specifically in relation to the development of a potential BCE Lab© based in the Greater Galway area.

- A BCE Lab© would appeal to early adopters in relation to the potential economic ‘added value’ of what could be achieved with waste and “end of life” fishing gear
- Two perceived strengths were seen to be partnership and job creation opportunities. The region could be a rich resource of project partners for a BCE Lab©
- Involving experts and practitioners with knowledge of issues related to waste and “end of life” fishing gear – particularly fishers - is crucial to the development of a BCE Lab©
- Early stage buy-in from manufacturers will be critical
- There would likely to be public support because of the public’s growing awareness of environmental issues including those around plastics and lost fishing gear in the oceans

[67] There are printed and online material available that can be used to explore the develop of a BCE Lab© concept

- Existing facilities in a) Connemara might be an ideal location for sourcing waste and “end of life” fishing gear from fishers and b) Údarás na Gaeltachta, or "Gaeltacht Authority” might be a good foundation for design, processing and manufacturing

There was also a range of specific comments on issues related to the development of a BCE Lab© and related modules in the Greater Galway area**.**

Design Lab

A strength of developing a BCE Lab© in Galway was seen to be access to cities’ creative industries and the cities involvement in the broader Creative Cities Network.[68]

Participants highlighted that Galway has strengths in design. However, it was pointed out that design needs manufacturing as much as manufacturing needs design. But what needs to come first to get a BCE Lab© “off the ground”: manufacturing expertise would be needed by designers to validate their early ideas and concepts but ideas for products are needed first! Both skill sets would need to be recruited or seconded to take forward a BCE Lab©; as well as funding.

Galway participants thought there would be a readily available and keen workforce to help conceptualise and visualise end user products (B2C or B2B) from waste and “end of life” fishing gear. A strength of the BCE Lab© concept was perceived to be the focus and structure, and that it could provide a useful meeting place for designers and other creatives interested in developing new solutions to waste and “end of life” fishing gear.

Participants indicated there would be little shortage of ideas for end user products but clearly there will have to be evidence of the market potential for products to be manufactured. Developing a freewheeling, lab-based culture with a focus on innovation and creativity within a BCE Lab© – incorporating a combination of trial and error, and market research and testing – was thought to be a useful process for bringing forward potential new commercial opportunities.

As the focus of a BCE Lab© is ultimately on the commercialisation of products from waste and “end of life” fishing gear, market evaluation and research will be important skills that need to be incorporated into innovation processes. Potentially partnering with JFC Group in Galway was thought

[68] https://en.unesco.org/creative-cities/galway

to be good strategy. To quote JFC Group, “We design and produce a range of innovative solutions for Agri-Equine, Construction, Material Handling and Marine professionals”.

Processing Lab

Existing manufacturers and other stakeholders might be engaged in a Processing Lab as investors and knowledge providers depending on the business model and funding of a BCE Lab© overall, or the individual modules or the combination of modules.

A key issue raised was the supply of the secondary materials and the processing costs involved including the cost of producing pellets, fibres and filament from fishing gear. The subject of what sort of processing would be involved in a Processing Lab© was also raised e.g. washing, drying, shredding, etc.

The discussion over a BCE Lab© highlighted several issues

- The potential benefits for local employment
- The possible use of vessels in Irish waters as part of a supply chain for waste and “end of life” fishing gear
- Existing knowledge should be recognised and built upon
- A pop-up Processing Lab might be efficient use of resources, space and skill sets as a starting point

Two key questions emerged in discussion

- Would unused stocks of waste and “end of life” fishing gear be available for use outside the BCE Lab©?
- Would waste and “end of life” gear be provided free of charge to a BCE Lab©, if collection is organised by a BCE Lab© with fishers and/or port, or harbour authorities?

Manufacturing Lab

Workshop participants discussed how a Manufacturing Lab might be moved forward through collaborative use of existing manufacturing capacity in urban or rural areas surrounding port or

harbour areas in the Greater Galway area. Within that context, reaching out to wider industries and stakeholders was thought to be important.

In addition, innovative approaches to manufacturing including the use of 3D printing might be considered to reduce costs. The technologies to be used in a Manufacturing Lab would therefore need close attention, as would be compatibility with secondary materials e.g. recycled polymers.

Targeting EU funding to develop manufacturing was also a key point raised.

Startup Lab

The subject of start-up costs and the need to find financial sponsors, investors or other funders was highlighted. In addition, another strategy would be to seek assistance from the New Frontiers programme[69] that is organised by Enterprise Ireland that supports early-stage entrepreneurship and innovative businesses. New Frontiers is based in 16 campus incubation centres across Ireland, with two in GMIT (one in Galway, one in Castlebar, Mayo).[70]

Údarás in Connemara was highlighted as a possible collaborator for Design, Processing and Startup Labs.

Also highlighted was the importance of

- Lobbying policymakers for legislative or regulatory change
- Seeking funding via Corporate Social Responsibility (CSR) programmes and venture capital (VC) investors
- Tapping into existing startup, incubation and maker space initiatives
- Networking amongst local stakeholders and also those outside the region e.g. funders
- Sharing knowledge of technologies

[69] https://gmitihubs.ie/new-frontiers2/
[70] https://www.newfrontiers.ie/locations/galway-mayo

3.2.3.4.5 Weaknesses

3.2.3.5.1 Ålesund

There was perceived to be a range of weaknesses associated with a) a BCE Lab© concept generally and b) the potential development of BCE Lab© specifically located in the Greater Ålesund area.

Key weaknesses were identified as

- Lack of a guarantee of a stable supply of waste and “end of life” fishing gear
- Quality issues associated with waste and “end of life” materials from fishing gear
- Logistical challenges and costs associated collecting, sorting, etc
- Knowledge gaps related to polymer and material technologies
- Lack of analysis of competitive projects.

More clarification and information were requested on

- Financial model
- On-site processing (including logistics)
- On-site (or other) product manufacturing
- Testing and certification

Additional comments included

- A BCE Lab© seemed to be a very good concept for start-ups but seemed less relevant for existing recycling and other companies
- Attendees were unclear about the role of a BCE Lab © in the whole value chain from the collection of waste and “end of life” fishing gear to commercialisation of products and this needed further explanation
- When crude oil is too cheap the viability of a BCE Lab© would be hit because of the fluctuating prices associated with recycled polymers
- There was a need for more information about funding, innovation, networking and logistics related to start-ups

3.2.3.5.2 Galway

There was perceived to be a range of weaknesses associated with a) a BCE Lab© concept generally and b) the potential development of BCE Lab© specifically located in the Greater Galway area.

A BCE Lab© would be costly to set-up from scratch if it's not a pop-up.

To be viable to be set-up, a BCE Lab© may need a university and/or research institution as an anchor partner and/or collaborator.

There needs to be clarity over

- Type of organisation
- Governance structure
- Leadership team
- Branding and positioning
- Financial support needed
- How the individual modules would function within the overall BCE Lab©, or outside
- Supply of secondary materials e.g. recycled polymers
- Quality of secondary materials e.g. contaminated fishing gear

If a BCE Lab© is based in a rural or port-based area, there might be potentially limited access to staff with appropriate skills and expertise e.g. it would be difficult to recruit the right people with all the appropriate skills in one physical space. However, it was felt that through online working it might mean that certain professional services could be accessed remotely albeit perhaps to the detriment of local employment. However, employees working on processing, logistics and manufacturing and/or assembly would need to be based locally. In addition, accessibility to a BCE Lab© by interested parties and workers living a distance away was also identified by participants as an issue.

Other perceived weaknesses included

- Potential lack of sharing of information, knowledge, expertise and other resources by some organisations in the local innovation ecosystem, perhaps being defensive and protecting their own interests
- The time intensive nature of establishing a BCE Lab© and significant project management time likely to be required in the early stages of development

- Being based in a single building was seen by some participants as less effective than operating as a virtual centre utilising broader industry and academic knowledge and resources. It was thought that creating relationships with what already exists might a useful strategy to pursue. A hybrid or "blended "model night also be explored
- The shortage of recycling infrastructure in Ireland for fishing gear cleaning and shredding was a constraint
- Another subject raised was that the implementation of EPR and requirement for recycling would create additional workloads for small teams that manage a harbour's existing activities. The team would have to address new challenges related to recycling of fishing gear – collaboration, liaison, and communication - with third parties
- The ability to cost-effectively comply with legislation and standards was also seen as a potential challenge
- In addition, variations in the quality of final products was also seen as an issue both in terms of recycled plastic pellets and final products produced from the pellets

There was also a range of specific comments related weaknesses associated with the development of a BCE Lab© and the related modules in Galway**.**

Design Lab

A Design Lab will be costly to set up if it's not a pop-up.

At the start-up phase of the BCE Lab©, it might be sensible to align a Design Lab with a university or research partner to take forward R&D related to products using recycled polymers from waste and "end of life" fishing gear.

Having all the necessary people with all skills in one physical space would perhaps be a challenge - but although "less (physical) communication" was seen as a weakness because of the rural location, good communication is possible through online channels.

There might be competition from small tech companies for physical space in Galway.

Other issues that were identified included

- Branding of the BCE Lab© and the modules would need assistance from a designer
- A lack of clarity over who would take the lead on a BCE Lab© and the Design Lab within it

- Risks associated with fragmentation of the model

Processing Lab

Processing would involve cleaning, drying and shredding fishing nets and ropes to enable the facility to produce e.g. plastic pellets, filament and/or potentially second life nylon fibres. Such a facility would require financial input from, for example, a local authority until the facility became financially viable. It was noted that processing of "ghost gear" might be an expensive exercise e.g. the processing of fishing gear that has been at sea for a long time and has been contaminated with biotic material e.g. seaweed, sand etc. See Annex 1 for examples of emerging solutions to address these issues.

There may be supply issues with insufficient quantities of material at times i.e. fluctuation in volume.

Setting up regional centres, acting as primary hubs - accepting waste and "end of life" fishing gear from small ports was mentioned as a useful strategy to consider. See Annex 1 and Annex 2.

Another cost issue would be the equipment required, which may need to be imported, would add to costs.

A Processing Lab would have to seek waste permits and comply with waste legislation including health and safety issues around duty of care to employees. In addition, there would be issues of quality of material production (plastic pellets, filaments and potentially second life fibres) due to fluctuating volumes of incoming waste and "end of life" fishing gear.

It was recognised that there would be an environmental impact of any washing system. Perhaps new technologies might be investigated e.g. is an ultrasonic washing system viable for use in a processing facility?

While a Processing Lab would be well suited to an initial low volume of waste and "end of life" fishing gear that will need to be cleaned and shredded, it would potentially have to rely on material brought in from elsewhere e.g. other ports, in order to meet the needs of a Manufacturing Lab or manufacturing partners outside of a BCE Lab©.

Finally, as a leading-edge processing facility, there would be a risk of investing too early – while, at the same time, potentially increasing the value of any early stage investment.

Manufacturing Lab

One recommendation was to partner with plastics companies e.g. JFC Group. Another was to consult with manufacturers as to the type of recycled polymers they could use and in what form e.g. pellets, filaments or fibres.[71]

Other points raised included

- Timescales around production including any "just in time" (JIT) manufacturing
- Logistics and transport, including selecting the most appropriate and cost-effective transport for delivery of waste or "end of life" fishing gear to a BCE Lab©
- The current lack of recycling infrastructure to collect, wash and shred fishing gear to produce pellets, filament or fibres (immature value chains)
- Fluctuating volumes of incoming waste and "end of life" fishing gear will be a challenge for the efficient operation of a Processing Lab. This could be addressed by bringing in waste and "end of life" fishing gear from other collection points e.g. harbours and ports further afield to a BCE Lab©
- A BCE Lab© might re-position itself as a primary hub e.g. BCE Hub© or BCE Innovation Hub©, or as part of a BCE Hub© and build partnerships with secondary hubs (see Annex 1 and 2)
- The collection and processing of "end of life" agricultural and horticultural polymers could help to smooth out fluctuations in supply of raw materials and potentially "add value" to a BCE Lab© or BCE Hub© offering

Startup Lab

A point raised at the workshop was that a Startup Lab would require physical space such as a unit and that companies in the tech sector might also looking for space i.e. there might be competition for space in Galway. In the short-term, a Startup Lab might be virtual to reduce space concerns.

[71] The production of fibres from nylon fishing nets will required a chemical recycling process to be established – it is unclear if there are small scale technologies available to do this at present. Further research is needed.

It was highlighted that BCE Lab© Startup Lab would also be a startup at the start of development the project. Another option would be for a Startup Lab to hosted by an incubator unit in Galway.

Other points raised included:

- Financial and scaling-up issues
  - Funding of the Startup Lab
  - Costs associated with prototyping
  - Scaling up companies based within the Startup Lab e.g. through an Accelerator programme either in-house or ex-house in Galway

- Challenges around skill sets
  - As highlighted earlier there might be challenges with gaining access to the right skill sets e.g. students in Galway might move to urban areas after graduating, whereas, waste or "end of life" fishing gear might only be accessible in remote areas where facilities will need to be based but skilled staff may not want to locate

3.2.4 BCE Lab©: Specific lessons learnt from the Ålesund and Galway workshops

A number of cross-cutting lessons were learnt from the discussion of a BCE Lab© concept in Ålesund and Galway.

3.2.4.1 Green light

- Generally, there was positive feedback on the BCE Lab© concept at both the Ålesund and Galway workshops
- A "green light" was given from attendees at both workshops to continue to further develop the BCE Lab© concept as it was thought to have some potential in relation to innovation opportunities that might arise from forthcoming EPR legislation
- However, there was some scepticism from fishing gear manufacturers/assemblers and fishing organisations as to the volume, availability and lack of predictability of the supply of waste and "end of life" fishing gear - which means that an initiative might be small scale
- Depending on the location, the volume of waste and "end of life" polymers sourced from fishing gear might be expanded to include waste and "end of life" polymers from agricultural

and/or horticultural sectors. This would provide additional feedstock for the Processing Lab within the BCE Lab©.

- Waste and “end of life” polymers from fishing gear might be sourced from other ports and harbours using a Primary and Secondary Hub model (see Annex 1 and 2)

3.2.4.2 Rebranding

The development of the BCE Lab© concept should be aligned with potential funding opportunities and might be better rebranded as a BCE Hub or BCE Innovation Hub© in order to tackle future requirements of EPR legislation e.g. recycling, reuse and reverse logistics related to waste and “end of life” fishing gear. The Processing Lab within a BCE Lab© might be designed to a primary hub being fed by secondary hubs from other parts a region surrounding the anchor port or harbour area.

3.2.4.3 Planning, leadership and management

- A BCE Lab© should be led and managed by focused, “driven” individuals with a passion for the subject, who have the people and management skills to bring different stakeholders with different agendas together with a common aim. Co-operation, collaboration and sharing of knowledge will be key, alongside focusing on a longer-term vision of circular fishing gear systems
- There is a need to get one or two fishers on board with the initiative from the start and then others are likely to follow. There must be no charge at any stage to fishers (see Annex 1 and 2)
- It is essential to plan for the EPR legislation and standards development in Europe that is targeted to be published in December 2024: plans, decisions and actions need to be started now. EPR will have a significant impact on the fishing industry, recyclers and associated businesses. For example, there will be a need to start to think about new opportunities and challenges that might result from fishing gear being designed to be easier to be repaired, disassembled, reused and recycled?

3.2.4.4 Co-ordination

- Interest was expressed in the Galway workshop that the BCE Lab© might to be developed as a virtual and/or hybrid concept e.g. it might play a role in co-ordinating existing assets online that are relevant to tackling waste and “end of life” fishing gear in Ireland and/or more specifically in the west coast of Ireland. This rationale is equally applicable to Ålesund and

indeed, elsewhere. The four BCE Lab© modules - Design, Processing, Manufacturing and Startup - could be located in Galway or Ålesund, or in different parts of their respective conurbations or regions

- There is a need to complete more extensive mapping of stakeholders related to waste and "end of life" fishing gear in the Ålesund and Greater Galway business, innovation and fishing sub-systems. The potential stakeholders for a BCE Lab© in Galway or Ålesund that were identified in the workshops need to be further researched. See initial listings in Annex 3 and 4.

3.2.4.5 Development

- To prevent long-distance haulage (e.g. region to region or country to country) of processed or semi-processed fishing gear or materials - with the associated carbon dioxide (CO2) emissions and financial costs - a local or regional circular economy model should be designed and implemented to tackle waste and "end of life" gear
- A BCE Lab© could initially be set up as a primary hub or as part of a primary hub e.g. a BCE Hub© or BCE Innovation Hub©, where smaller, secondary hubs can send waste and "end of life" fishing gear collected by fishers and volunteers in other regions. The BCE Hub© or BCE Innovation Hub© might then act as the liaison point for third parties e.g. recyclers and/or manufacturers, and also might be a location where waste and "end of life" fishing gear is processed. More specifically the Processing Lab might act as the primary hub and as centrepiece of the BCE Lab© with the other modules aligned to it. Secondary hubs might be created as the primary hub expands its operations (see Annex 1 and 2)
- There is a need to focus on volume, ease of collection and gaining access to waste and "end of life" fishing gear that might also be "stored" in harbours. A decision might be made to just focus on "end of life" fishing gear as collecting "ghost gear" (waste gear) at sea will be time consuming and costly unless it's completed by volunteers e.g. Fishing for Litter[72]
- Recyclers should be recruited who can process waste and "end of life" fishing gear. However, this may mean that schemes and incentives need to be developed to enable entrepreneurs and waste management companies to move into the area.
- There will need to be the development of a list of authorised recyclers because not all recyclers will be able to handle fishing gear, particularly very large fishing nets

[72] https://fishingforlitter.org/

- Relationships should also be established with voluntary groups e.g. divers and beach cleaners, to channel the salvaged and collected waste fishing gear to the primary and subsidiary hubs
- To increase awareness and engagement, there will be a need for the development and communication of checklist of the actions that individual stakeholders will need to undertake in relation to responsibilities related to the forthcoming EPR legislation for fishing gear

3.2.4.6 Location

- A key question will be where best to locate a BCE Lab© and/or the respective modules in each area e.g. are there obvious existing hosts for all four modules or individual modules in one place or different places in the urban or rural areas surrounding port or harbour areas or in the region surrounding the location?
- It is particularly important to identify where to best locate the Processing Lab e.g. at or near a port or harbour, or potentially at a regional level in proximity to several ports or harbours. This would allow for the supply a higher volume of waste and “end of life” fishing gear to one primary hub (see Annex 1 and 2)
- A key consideration will also be how best organise physical and virtual aspects of the BCE Lab©. Perhaps Design and Startup Labs might be hybrid (virtual or physical) spaces, whereas Processing and Manufacturing Labs would need to be physically located

3.2.4.7 Positioning

- A BCE Lab© should be positioned as a business and/or R&D venture that may have a potential role to play in relation to the implementation of the forthcoming EPR legislation for fishing gear
- It is important to recognise that a BCE Lab© is proposed as just one solution within a portfolio of solutions to waste and “end of life” fishing gear issues. It is not suggested that BCE Lab© is *the* solution to problem.
- A BCE Lab© might be positioned to complement other solutions being developed by other stakeholders and perhaps help kick start the development of new ideas and solutions e.g. new circular products and business models.

3.2.4.8 Small scale

- The feasibility of a BCE Lab© will depend on the volume of waste and “end of life” fishing gear that can be supplied. There is a need for much better data on the volume of waste and “end of life” fishing gear by port, region and overall. As indicated above, the feasibility of BCE Lab© could be improved if waste and “end of life” agricultural and horticultural plastics were considered as an additional input into the Processing Lab. The volume of these types of “end of life” plastics in the communities surrounding a BCE Lab© would need to be quantified.
- A proposal for a fishing gear recycling facility in Scotland was not taken forward because of the lack of predictability of the volume and timing of waste and “end of life” fishing gear. However, at the time of the completion of that feasibility study there was no proposed EPR legislation for fishing gear being discussed. The UK (including Scotland) is presently considering policy options to tackle waste and “end of life” fishing gear that might include EPR[73]

3.2.4.9 R&D

- There may be opportunities to align a BCE Lab© and/or individual modules with existing funding initiatives. For example, it was stated in the Galway workshop that an Irish manufacturing initiative might be targeted for funding as it had a €25 million budget
- There was discussion over whether BCE Lab© and/or individual modules could be piloted within existing initiatives and/or with specific organisations
- An alternative route for the development of BCE Lab© would be to piggyback on relevant existing facilities, skills, expertise and equipment. This strategy would mean that additional funding might not be required to get a BCE Lab© off the ground
- An agreement might be completed with different organisations in different regions where ideas could be de-risked, developed and prototyped. For example, in Ireland such an agreement might be made with the Irish Manufacturing Research Council (IMR) that has “state of the art” facilities that allow companies to trial new manufacturing processes before scale-up. At the Galway workshop, there was a proposal for an evolutionary development approach for a BCE Lab© with six months’ R&D at IMR followed by six months R&D at a facility such as the Data Analytics Centre in National University of Ireland Galway (NUIG)

[73] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765914/resources-waste-strategy-dec-2018.pdf

and then perhaps six months R&D at the Marine Institute. The feasibility of such an novel, evolutionary and multi-stakeholder approach to a BCE Lab© development should be further investigated

3.2.4.10 Funding

- As indicated elsewhere in this report, there is a need to attract start-up funding, or other financial and/or in-kind support to develop a BCE Lab© and/or the individual modules. Initially this might be via a local authority, harbour/port authority or regional development agency funding
- The longer-term aim of a BCE Lab© would to be financially viable; that might be realised through commercial activities including establishing a Startup Lab to fast-track business start-ups. Other income generation arrangements might be explored including revenue-sharing related to licencing, patents, etc
- There needs to be financial modelling of a BCE Lab© concept to define costs and revenue short, medium and long-term more specifically

4. CONCLUSION

Waste fishing gear present hazards to marine life – from fish to mammals and crustaceans – in Europe, the NPA region and the world over. For example, on the seabed of Sweden alone there are tens of thousands of lost and discarded lobster pots - ghost lobster pots – that have accumulated over decades and continue to do what they were designed to do: trap desired sea life (see Annex 1).

Waste and “end of life” fishing gear is largely composed of nylon, polyethylene and polypropylene with potential for repair, reuse and recycling if captured at the right stage in its lifecycle. With the implementation EC’s SUP (and EPR regulation within it) and Port Reception Facilities (PRF) Directives, the EC will require fishing gear producers and assemblers to implement systems to responsibly manage, dispose and recycle fishing gear. This will have implications for all stakeholders in the fishing gear value chain. In parallel to the EPR system for fishing gear to be published in December 2024, there will be the publication in 2024 of seven new European standards related to circular design and recycling of gear – these are now starting to be drafted within CEN TC 466. EPR comes into force in Europe in 2025[74] and member states will be expected to have established EPR schemes for fishing gear by that date. At present other countries e.g. Norway and UK are also considering policy options to deal with waste and “end of life” fishing gear that include EPR.

Waste and “end of life” fishing gear presents huge challenges at sea and on land. Where it has traditionally been disposed of via landfill (or incineration, regardless of the condition it is in) – it also presents opportunities. These challenges and opportunities include: a) environmental: waste and “end of life” fishing gear can be processed, recycled and upcycled, rather than being buried or burned, b) social and business: jobs might be created through hubs and associated businesses being set up in remote areas – ports/coastal towns - where job prospects can be poorer than elsewhere.

Through encouraging innovation within a local circular economy, a BCE Lab©, or BCE Hub© or BCE Innovation Hub© type operation would help to introduce new and wider skills sets in the NPA region. At the same time, a BCE Lab©, or BCE Hub© or BCE Innovation Hub© could play an active role in

[74] https://marketac.eu/wp-content/uploads/2020/02/DG-MARE-Presentation-EPR-Schemes.pdf

knowledge generation and exchange through collaboration and co-operation, and help to set best practice standards pre- and post- the introduction of EPR in 2025.

A BCE Lab©, or BCE Hub© or BCE Innovation Lab© that takes on the role of a primary hub in a port or harbour area could draw together all the points highlighted in this report to produce a solution to the dual problems of what to do with waste and "end of life" fishing gear in areas with often high unemployment and low skill levels.

A BCE Lab©, or BCE Hub© or BCE Innovation Lab© could help link up start-ups and other embryonic projects in local innovation ecosystems by providing a mechanism to enable collaboration across skills, knowledge, sharing of assets, training, manufacturing, marketing and invention amongst universities and research groups, and retailers seeking to developing "greener" products for an increasingly sustainability-aware consumers. BCE Lab©, or BCE Hub© or BCE Innovation Lab© could also learn from and build on best practice that has already been developed at Sweden's Sotenäs Marine Recycling Centre (Annex 1) and Canada's Steveston Harbour Authority in British Columbia (Annex 2).

Engaging with fishers at the start is essential. With their buy-in, and payment, fishers could be crucial to preparing waste and "end of life" fishing gear for processing prior to manufacturing, because, as Joel Baziuk says in Annex 2, "Nobody can strip a net better than fishers. They can do it much more efficiently than anybody else. They have worked with nets for their entire lives".

Smaller port or harbour areas could act as secondary hubs supplying a primary hub with cleaned and sorted waste and "end of life" fishing gear, with a primary hub itself being the collection point where fishers local to it take their own unwanted gear and disassemble for recycling and product development (see Annex 1 and 2).

Within the context of EPR, secondary hubs could work closely with a primary hub that might be, in effect, a Processing Lab within a BCE Lab© or part of a broader BCE Hub© or BCE Innovation Lab©. In turn, a primary hub would operate in tandem with its local and/or wider regional authorities, businesses, entrepreneurs and other stakeholders. The purpose would be to help create a "greener", more local/regional circular economy.

A primary hub's reach could be regional or national dependant on the size of geographical size of the country and the size of the fishing industry, with the goal of, for example, keeping polymers within the countries' territory and stimulating the use of secondary materials by manufacturers within the

borders. The aim would be to stop the export of a low value material and increase its value (potentially many times), while protecting jobs and helping to “bring jobs home” – and reducing the environmental impact of exporting (see Annex 1).

ANNEX 0: NPA REGION

The NPA Programme 2014-2020 covers a vast area, as shown on the map below. The programme partner countries are the EU Member States of Finland, Ireland, Northern Ireland, United Kingdom and Sweden and Non-EU Member States Faroe Islands, Greenland, Iceland and Norway.

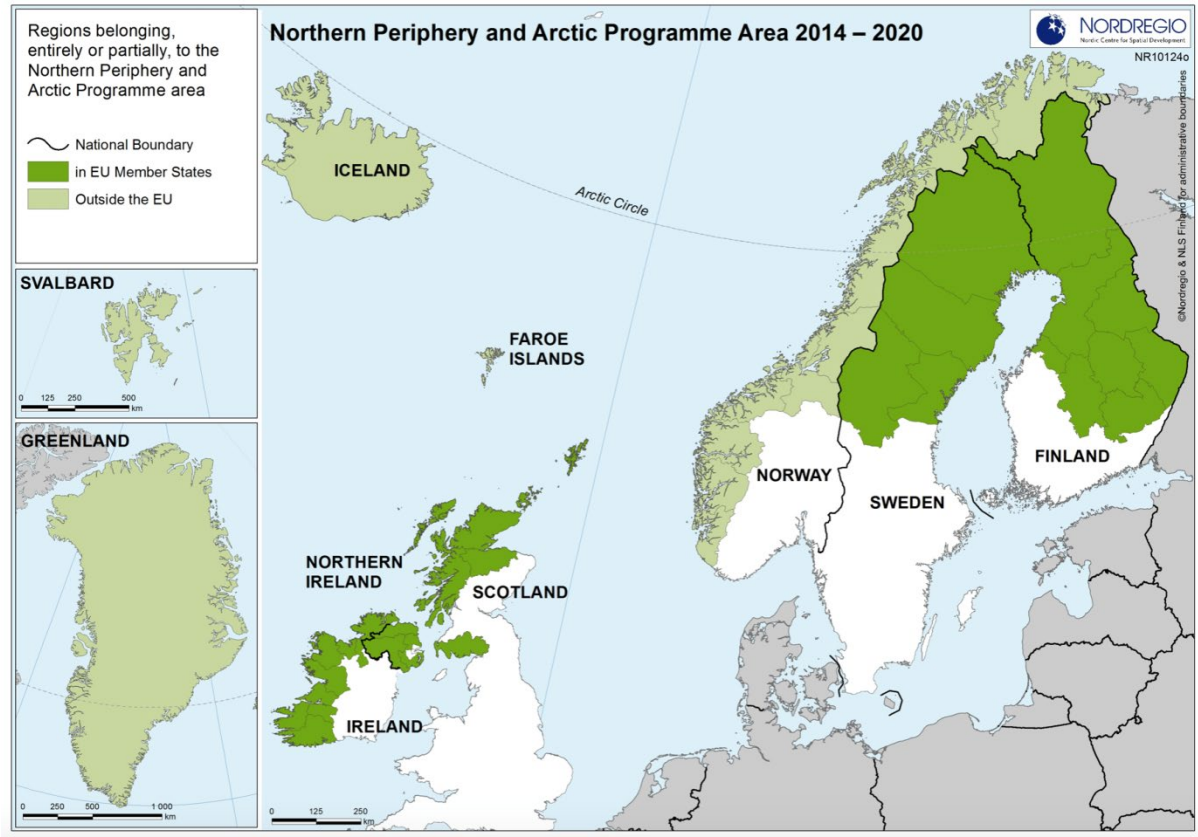


Figure 1: NPA region (sourced from http://www.nordregio.org/maps/interreg-v-b-northern-periphery-and-arctic-region-programme/)

Eligible regions within the NPA are (also see above map)

The NPA region covers a large programme area and despite the geographical differences shares several common features, such as low population density, low accessibility, low economic diversity, abundant natural resources, and high impact of climate change. This unique combination of features results in joint challenges and joint opportunities that can best be overcome and realised by transnational cooperation.

EU Member States

Finland

- FI19 Länsi-Suomi (Keski-Suomi)
- FI1D Pohjois-ja Itä-Suomi

Ireland

- IE01 Border, Midland and Western (County Donegal, County Galway, County Leitrim, County Mayo, County Sligo)
- IE02 Southern and Eastern (County Clare, County Cork, County Kerry, County Limerick)

Northern Ireland

- UKN0 Northern Ireland (excluding Belfast and Outer Belfast)

Scotland

- UKM32 South Western Scotland (Dumfries and Galloway)
- UKM6 Highlands and Islands

Sweden

- SE32 Mellersta Norrland
- SE33 Övre Norrland

Non-EU Member States

Faroe Islands

- FO Faeroerne

Greenland

- GL Greenland

Iceland

- IS Island

Norway

- NO43 Rogaland

- NO05 Vestlandet
- NO06 Trondelag
- NO07 Nord-Norge
- SJ Svalbard and Jan Mayen

ANNEX 1: SOTENÄS MARINE RECYCLING CENTRE, SWEDEN: A CASE STUDY ON FISHING GEAR RECYCLING, CIRCULAR DESIGN AND INNOVATION

Introduction

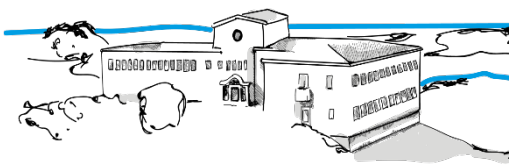
This case study is based on an interview and correspondence with Peter Carlsson, Project Developer, Chalmers Industriteknik, and Symbiosis Developer for Sotenäs Symbioscentrum (which includes Sotenäs Marine Recycling Centre (SMRC)), Erik Goksøyr, Project Developer of SMRC, and Emily-Claire Goksøyr, Project Manager of the development of SMRC's testbed. The interview was conducted on 5th March 2021, and was followed up by subsidiary interviews and correspondence.

Sotenäs Centre of Symbiosis (Sotenäs Symbioscentrum)

Sotenäs Centre of Symbiosis (Symbioscentrum) is an industrial and social symbiosis organisation that was founded by Sotenäs Municipality in 2015. The goal is to apply industrial symbiosis (waste = "food") principles to strengthen the local economy socially, economically and environmentally. The creation of new jobs and encouraging new companies to be established is a key part of the strategy.

The desired result is a very well-integrated system that covers many different types of waste produced by the municipality and views waste as a potential opportunity. Sotenäs Symbioscentrum aims to develop synergies between industrial players involved in renewable energy, food production, aquaculture, algae production, marine technology and innovative products, upcycling waste heat, fish industry waste and other wastes from the neighbouring sea to create jobs (many of them "green), value-added products and processes, and improvements in material and energy efficiency in the region.

Figure 3: Symbioscentrum concept



SYMBIOSCENTRUM

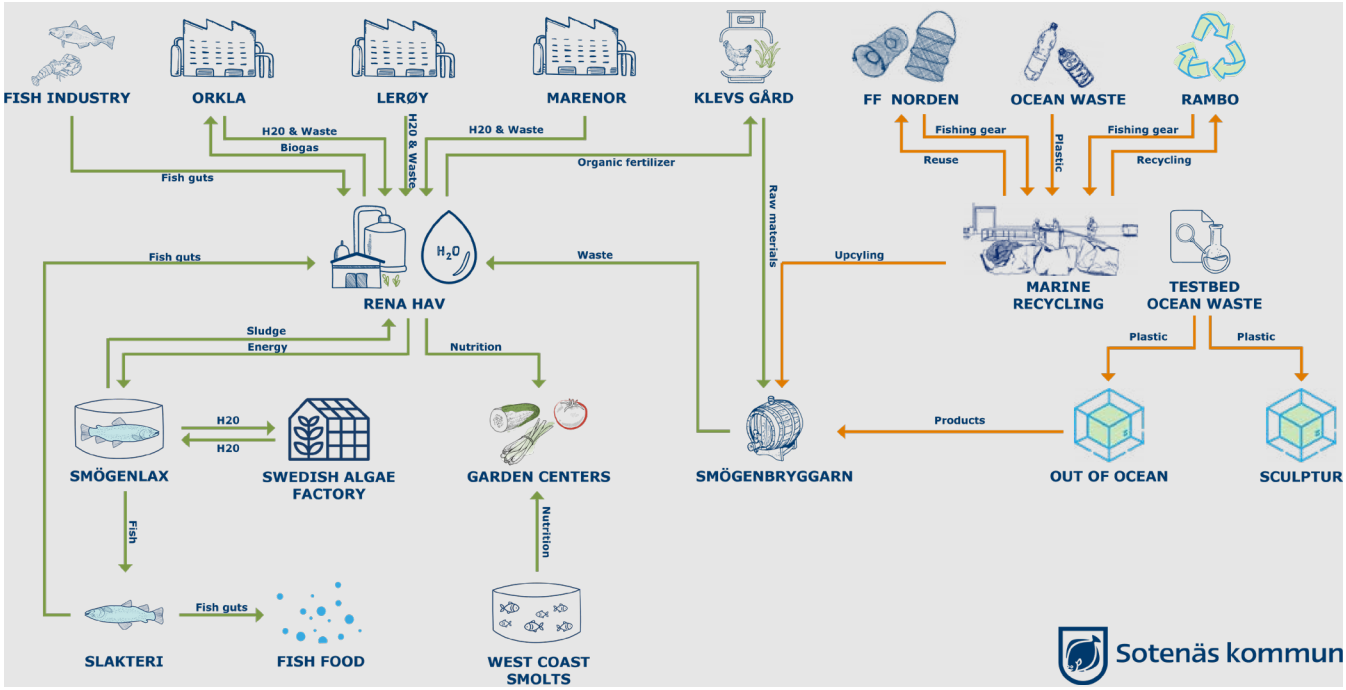
KNOW HOW - FACILITATOR - CATALYST

Symbioscentrum's vision

When it started in 2015, Symbioscentrum stated that its vision was to develop a complete end-to-end system encompassing three core projects: a biogas facility and wastewater treatment plant (WWTP) managed by Rena hav, and recycling of waste and "end of life" fishing gear (and plastic beach litter).

The starting point was biowaste and wastewater from the local fish processing industries to produce biogas, recycling of fat from restaurants to produce bio-diesel (no longer in operation) and plastic recycling together with Fiskareföreningen Norden (FFN), also known as Nordic Fishermen Association (NFA). In parallel, there were ongoing "Fishing for Litter" and beach cleaning initiatives. When the activities started there were ideas of recycling the plastic locally, but at that stage they were only in the early stage of conceptualisation and development.

Figure 4: Symbioscentrum system



In its broader picture, the vision included producing local food and manufacturing products in a self-supporting, financially viable closed loop circular system: a circular economy-based rejuvenation programme involving job creation, upskilling, investment, added-value and more efficient, "greener" use of local resources.

In 2018, Symbioscentrum brought different projects together under one “roof”. For example, one project was an Interreg project called “Ren Kustlinje” (“Clean Coastline”) and another was a nationally funded project to clean beaches from ocean waste aiming to reduce the problem of plastic in the oceans from the fishing and other industries. With the projects as a base, SMRC was established by Symbioscentrum. Initially, Sotenäs Marine Recycling Centre (SMRC) was designed as a small factory to disassemble fishing gear, sort the different materials and prepare materials for reuse and recycling.

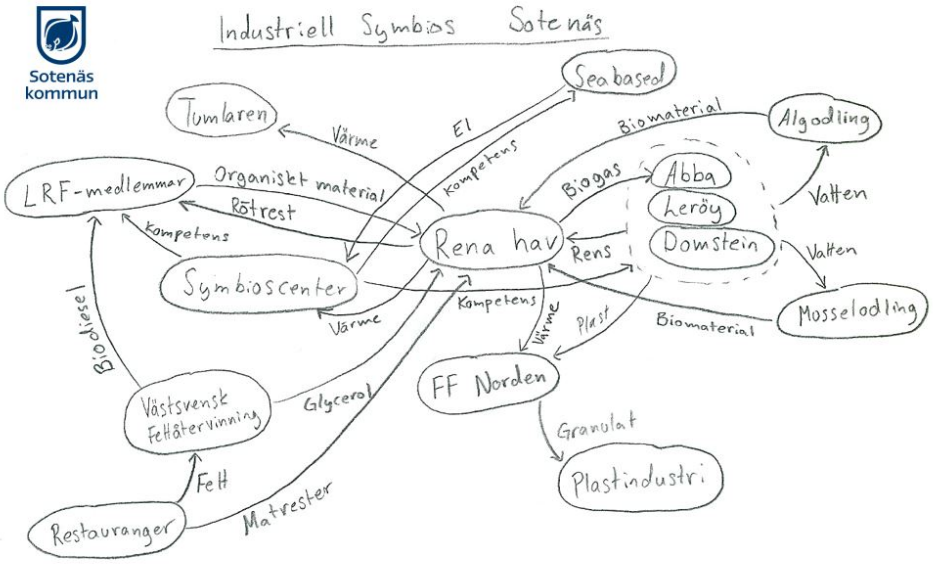
Management structure: The people behind Sotenäs Symbioscentrum and SMRC

Sotenäs Symbioscentrum is managed by Per Svensson, who currently (November 2021) works directly under the municipality board headed by Maria Vikingsson, Director of Sotenäs Municipality, who has full responsibility for SMRC[75]. Another key role and person is the municipality’s, as well as Symbioscentrum’s development strategist, Leif Andreasson.

A steering group was established by Symbioscentrum in 2015 to drive development via projects. At November 2021, the group comprised Maria Vikingsson, three large companies (Orkla, Leröy and Marenor) an SME (Rena hav), University West, Innovatum Science Park, a venture capital organisation and local politicians. The steering group was led by Per Svensson, and later Peter Carlsson (now based at Chalmers Industriteknik[76] (CIT)), who was involved in the start-up phase of SMRC - setting up the structure and arranging the supporting finance.

[75] Background video on SMRC: in Swedish with English subtitles. symbioscentrum.se/projekt/marinatervinningscentral.4.72c6ff61174737cf53eddbb6.html
[76] CIT is involved in different projects related to SMRC, design of circular fishing gear and the testbed project chalmersindustriteknik.se

Figure 5: First symbiosis map of Sotenäs



Peter was originally employed by the municipality as a developer at Symbioscentrum, before joining CIT to support the development of SMRC and other projects. SMRC has been, and still is, financed by a mix of internal resources and externally funded projects.

SMRC and its vision

The SMRC vision is to be a flagship for innovation and knowledge related to ocean plastics and fishing gear that works with the whole value chain from design, collection and recycling. SMRC also aims to develop new circular economy products.

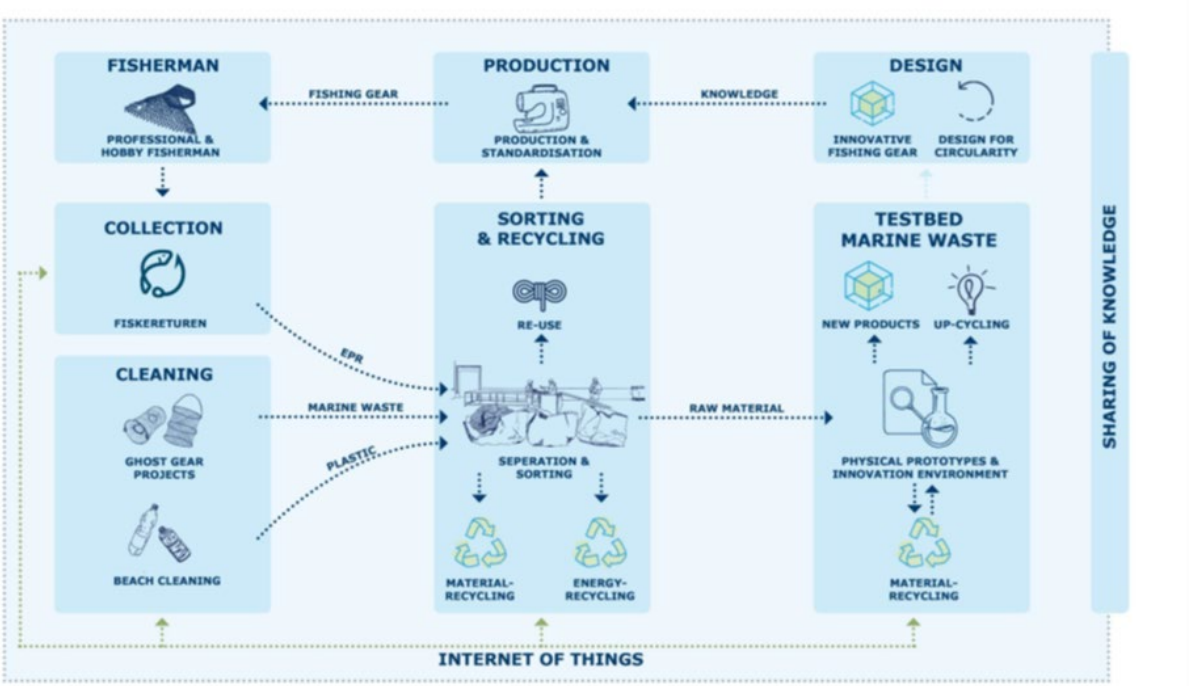
SMRC is based in Sotenäs, a small coastal municipality with a strong fishing and marine culture. Sotenäs has a population of about 9,000, which increases, through tourism, to more than 50,000 during the summer months. The municipality is 122 km by road north of Gothenburg, Sweden.

Founded by Sotenäs Municipality in 2018 as part of Symbioscentrum, SMRC is backed by strong political will and engagement from the fishing community. It is Sweden's first and, so far, only marine recycling centre, and thought to be the first of its kind in the world.

Key tasks during SMRC's start up stage included securing funding, small scale sorting, building a network, facilitating the development process and arranging logistics and material analyses. The design and initiation of subsequent projects involved many different partners.

To recap, SMRC is the part of Symbioscentrum that focuses on collecting and processing ocean marine plastics including waste fishing gear. The discarded and "end of life" fishing gear processed by SMRC includes nets, cages (including lobster pots) and marine plastics found on the beaches. In addition, through its testbed - working with a series of partners - it aims to identify those polymers that are best suited for use in manufactured products.

Figure 6: Sotenäs Marine Recycling Centre (SMRC in 2021)



Until September 2021, Erik Goksøyr led the development of SMRC and Emily-Claire Goksöyr acted as the project manager of SMRC's testbed[77]. Both Erik and Emily-Claire reported to Leif Andreasson at Sotenäs Municipality. The current project manager for the testbed is Maria Petersson. As part of SMRC's development, in June 2021 the municipality hired a site manager – Thomas Ericsson. There

[77] http://symbioscentrum.se/projekt/marinatervinningscentral.4.72c6ff61174737cf53eddbb6.html

is now a growing team working on SMRC and the testbed, drawn from different departments within Sotenäs Municipality.

As mentioned previously, SMRC processes discarded and “end of life” fishing gear e.g. nets, cages, etc (including lobster pots) and marine plastics from beaches of the coastal area around Sotenäs. It was established primarily to start to help tackle the problem of what to do with the large quantities of historic fishing gear left in harbours and in the sea and, in some cases, washed up on beaches. It’s a problem for many parts of the world and Sotenäs is no exception.

The prime waste management route for “end of life” and retrieved ghost gear in Sotenäs and many other countries has, traditionally, been sending it to landfill. However, beach cleaning and the sorting of marine plastics had been carried out by Sotenäs Municipality and volunteers for decades before SMRC was founded. More recently, NFA became a promoter of cleaner seas and beaches, and began to supply the Sotenäs Municipality, and then SMRC specifically, with “end of life” and “ghost” fishing gear.

As highlighted earlier, SMRC’s origins were based in a series of projects[78] - involving organisations from Sweden, Denmark and Norway - which addressed what to do with plastics from fishing gear and other plastics. One of those projects was the Interreg funded Clean Coastline project that had different work packages including different areas of R&D. Sotenäs Municipality supported SMRC and R&D projects through the time of some of its employees, and facilities which included buildings, boats and equipment.

A spin-off from the Clean Coastline programme was the creation of a beach cleaning map of West Sweden.

Polymers and metals

Polymers from beach cleaning and the collection of “ghost” and “end of life” fishing gear provide SMRC with the opportunity to use industrial-scale recycling to produce pellets that are used to produce products including furniture, building materials, footwear, clothing via participating makers and manufacturers. SMRC focuses on three main polymer categories from the following gear fishing

[78] symbioscentrum.se/download/18.28b810b6167ac1d153b1039/1544794849470/ Ren Kustlinje Resultatrapport Nov 2018.pdf

nets (mainly polyethylene (PE)), monofilament nets (mainly polyamide (PA) e.g. nylon) and ropes (mainly PE and polypropylene (PP)). The types of nets collected include pelagic trawls[79] and other, smaller net types.

A range of metals and plastics are recycled. The precise mechanism for sorting, or which fractions are to be sorted, have not been finally decided and there will be trials during 2022. As at November 2021, the sorting fractions were:

Metals

- Iron
- Lead
- Lead, mixed
- Lead ropes
- Stainless steel
- Copper
- Mixed metal

Plastics

- Combustible black (>1,5 meter: very dirty, mix PA and PET etc)
- Combustible blue (<1,5 meter: very dirty, mix PA and PET etc)
- Polypropylene (PP) mix (very little)
- PP ropes, blue lines
- Polyethylene (PE) nets, green
- Polyethylene terephthalate (PET) nets and ropes
- Polyamide (PA) nets
- Mixed ropes (PP and PE, not PA)
- PE nets, mixed

“Floats and objects that can be reused are sorted separately,” says Erik. “We have around 20-30 different fishing gear components and sub-components that can be recycled when sorted by polymer

[79] Pelagic trawls are cone-shaped nets that are towed behind one or two vessels and are designed to catch fish in the mid and surface water.

type. They include buoys, balls, floats, and metal parts e.g. shackles. Typically, they are 'waste' that can be reused in some capacity."

Metals in waste gear are also processed (sorted, broken up and compressed) by SMRC, and include lead (pure), lead (dirty), lead lines, mixed metal (which is the main percentage) and stainless steel wires.

Fishing gear that is heavily contaminated - by bioaccumulation, sand, seashells, etc - and that can't be recycled or upcycled, is transported to an incinerator in Uddevalla located 60 km east of Sotenäs, where the material is used for the generation of heat and electricity in the Uddevalla district heating scheme. Metal parts are removed for recycling or upcycling. The contaminated mixed polymer ropes, polyvinyl chloride (PVC) and broken objects are used as "feedstock" for the incinerator.

In the past, most of the *clean* polymers were exported to Plastix Global in Denmark for shredding and mechanical recycling into pellets for use by manufacturers in Europe and elsewhere. "However," says Peter, "we are seeing a shift now, where more and more polymers are being used in Sweden, not going abroad, with different companies using different types of polymer."

The majority of polymers come from Sweden's "industrial scale" fishing fleets - rather than from ghost gear[80] - because, as mentioned earlier in this report, it's easier and lower cost to obtain "end of life" gear from them than to scour the seas for "ghost gear". However, "ghost gear" has not been forgotten.

Nationally, efforts to retrieve "ghost gear" and "ghost lobster pots" are carried out voluntarily by divers and fishers as well as retrieval programmes that are funded by various organisations. The programmes include a Sotenäs Municipality-led project - funded by a mix of the national government, agencies and the municipality - which hires fishers and divers to retrieve lost gear. It's a collaborative effort between Sotenäs and the neighbouring municipalities of Tanum and Lysekil. This project is in addition to the retrieval voluntary work of divers and fishers.

SMRC is now accepting "end of life" gear from other coastal regions of Sweden, thanks to funding from the Swedish Agency for Marine and Water Management's department for the nationwide collection initiative called Fiskereturen (or "Return of Fishing Gear"). The initiative, started in

[80] https://www.worldwildlife.org/stories/ghost-fishing-gear

December 2019 and is a partnership between Sotenäs Municipality, NFA[81], Båtskroten Boat Scarp Service, and Keep Sweden Tidy Foundation ("Håll Sverige Rent").

"In Sotenäs, we accept various fishing gear because it has nowhere else to go in terms of what can be done with it. We now have people, mainly fishers and divers - a mix of volunteers and paid people - bringing ghost and other fishing gear from all over Sweden to us for disposal and recycling," says Erik.

Lobster pots

In the waters in the Sotenäs area, several hundred ghost lobster pots are retrieved each year. To put that in context, ghost lobster pots have been gathering on Sweden's seabed for decades, with the result that there is estimated to be tens of thousands of them, many still trapping sea life. Those retrieved and in a useable condition are sold directly to fishers and via the municipality's "Second Hand Store". Some are cleaned and given minor repairs at the recycling centre before being sold.

"They sell quickly," says Erik, adding, "We are also looking at collaborating with a company that is interested in carrying out more comprehensive repairs and including innovative solutions to reduce entrapment of fish, crabs and lobsters in case the recycled pots are lost again."

Hubs

During 2020, it is estimated that SMRC processed more than 170 tonnes of waste and "end of life" fishing gear that had been collected locally and from elsewhere in Sweden through hubs located in the different regions of the country. There are around 10 hubs in total, located in fishing villages and ports, from where gear is transported by truck to SMRC.

Hubs are typically where fishers often get their fishing nets repaired by fishing gear producers, although many fishers will repair and patch their own nets. The producers and fishers repair and adjust gear for best performance and to extend product life while adhering to the appropriate technical regulations for fishing gear.

[81] Fishers and fishing gear producers, locally established in the municipality. See ffnorden.se

Fishers who don't plan to repair the fishing nets themselves drop their gear off at the hubs. In some cases, fishing gear is collected from the fishers by Fiskereturen (Return of Fishing Gear) and taken to a hub, at no cost to the fishers.

Testbed

SMRC is developing a testbed - "Testbed Ocean Waste"[82] (TOW) - where different tests are carried out on the material derived from the initial processing of waste fishing gear and beach litter that is beyond reuse, repair or upcycling. The tests use different production methods and consider different applications for the polymers. The goal is to support participating companies with their own innovation, for example, by advising them how to apply the tests and the results to new "circular products".

"That goal supports an aim of SMRC to 'Keep it all in Sweden'," says Erik. "A circular economy model keeps, or helps to keep, material/value locally, in Sweden, rather than it going overseas."

TOW is partly funded by Vinnova, the Swedish government's Innovation Agency, and is run by Sotenäs Municipality and its testbed partners. The partners are CIT, which provides academic expertise and consultancy related to energy, materials, digitalisation, design, and project management and other support related to circular economy thinking and practical application; Research Institute of Sweden (RISE)[83]; NFA; and University West.

TOW is a part of a network of testbeds in Sweden that includes the testbed for plastic recycling run by RISE in Gothenburg, where RISE has a huge variety of instruments and research equipment including a large scale 3D printer, fibre spinning, larger injection moulding and extrusion machines - for the production of pellets - and equipment for analysis and testing managed by RISE. RISE performs different tests on the materials to determine the properties of the polymers.

The motivation for companies to use TOW comes from a growing interest in transforming waste to value by incorporating marine plastic in products by upcycling or reuse, or by recycling polymers to produce pellets prior to manufacturing final products or product parts.

[82] The text and video is in Swedish but it has subtitles in English. youtube.com/watch?v=QfJ1gZ2vdDo
[83] Plastic recycling laboratory. Plastic recycling and use of recycled plastic ri.se/en/what-we-do/expertises/plastic-recycling]

Companies participating in the TOW project, co-finance their participation by providing in-kind funding related to staff time and other contributions to the value of 100,000 - 200,000 SEK per company.

Ten companies are participating in TOW and a further two are in the process of joining. They range from small start-ups to large and global organisations and include producers of furniture, interior design objects, clothing and accessories and automotive components. The companies are Sculptur – 3D printing furniture; Out of Ocean – interior design and building material; XV Atelier – fashion; Scandinavia Form – interior design; add:north – 3D filaments; Rewyld – accessories; Store Enso – Biocomposites; Appelviken watches – watches; and IAC Group – automotive components.

Two new companies are negotiating participation. These are Impossible Plastics (which recycles 100% of all plastics, for use in products), and the Green Ideas Group[84], whose pyrolysis technology enables plastics to be “transformed into oil, gas and carbon black” at lower temperatures and without a catalyst.

TOW uses SMRC-owned equipment that includes a large and a small shredder (to create fibres/flakes, from which pellets are made by RISE and other external partners, via its compounder); an oven; a customised compression press; a small scale/prototype scale injection moulding machine; extrusion machine; and a small scale 3D printer along with handheld tools and machinery.

The equipment, processes and analyses are complemented by RISE’s polymer recycling laboratory - the biggest in Sweden - in Gothenburg.

Erik adds, “Tests carried out at TOW and, where necessary, at RISE, are driven by the requirements of the participating companies and partners. In some cases companies want information on the specific properties of a plastic, for example, to help them decide if additives need to be added to a plastic to help optimise the final consumer or business to business product. New product prototyping is primarily carried out on the companies’ own production lines.”

Tests, analysis, sorting and the use of equipment at SMRC are provided free of charge for participating companies but they are expected give feedback to SMRC and TOW for development

[84] https://greenideasgroup.com/

purposes (as part of the companies' in-kind in the project). Other benefits to companies are assistance related to circular business development and innovation provided by Symbioscentrum, and the opportunity for companies to join Symbioscentrum's larger network of companies, institutes and research organisations.

The tests provide a data-led basis for innovation. Peter comments, "The testbed is customer-led and so responds to requirements and requests from the participating companies. It started from a clean sheet, not knowing what the companies would be interested in, or what methods, fine-tuned to each of them, they required. But we quickly adapted, in close partnership with them."

Says Erik, "TOW's participating companies come from throughout Sweden. That's good, but overall, we prefer at least some makers to be more local as we look to job creation in the circular economy in Symbioscentrum.

"Some of the companies have successfully tested and developed products with the help of TOW and are soon to launch new products. The next challenge, which we are working on, is to secure a larger scale production and flow of material to and from SMRC, all within Sweden."

To summarise, TOW is developing and applying tests, and this process is indicating which tests perform the most closely to participating companies' needs. The tests also provide a data-led basis for innovation for the participating companies. In addition, TOW is producing a number of prototype "circular products".

The work at TOW, and lessons learned there, are helping SMRC to get more involved in developing standards for use in the circular design of fishing gear and other areas.

Social

There is also a strong social element to SMRC. The municipality's work training programme includes trainees from: (i) the local unemployed, who gain work experience, and (ii) migrants and refugees who benefit from becoming better acquainted with Swedish culture and language, developing social skills and better understanding the Swedish work environment. All trainees receive an income from the municipality.

The trainees' work covers separation and sorting of the fishing gear and beach plastic. In addition, they help to clean the beaches and coastal area of the municipality when the weather allows for it –

primarily, but not exclusively in the summer. This way they gain experience of both indoor and outdoor work while making a positive contribution to cleaner beaches and improve their prospects for re-entering the workforce locally or elsewhere in Sweden.

Challenges

Funding

“An early challenge was gaining funding. The resources required to do what we are doing needs funding because SMRC was not a commercially viable entity, although multiple benefits can be leveraged from it,” says Peter, adding, “Key for an operation like SMRC is public funding with the long-term aim of achieving commercial viability via the supply to businesses of recycled and other post-processed raw materials of high value.”

Bringing other parties on board

Says Erik, “A further early-stage challenge was getting fishers and producers to work with us, but the fishers didn’t really present much of a problem to engage because, as represented by the NFA, they were keen to help and in fact were a key partner from the beginning. Members even voluntarily collected fishing gear, at their own docks, for several years before SMRC was started. The NFA has been supporting the centre and been a driving part of it from day one.”

Different stakeholders, different responsibilities

Another challenge arose from SMRC working with a variety of different stakeholders, each with its own, different responsibilities but all being unsure over what to do with marine waste.

“The biggest problem,” Peter comments, “was who was responsible for marine waste, because it fell between different bodies. That means that even though waste fishing gear - for example - was the same, whether it is in the ocean, has floated ashore or is lying in harbours, the question of which agency should do what with the waste was generally not addressed.

“Historically, that created confusion and wasted time, but now SMRC is helping to co-ordinate things more effectively.”

The agencies involved – with their responsibilities are in brackets - include the Swedish Environmental Protection Agency (SEPA) (waste on land/beaches), Swedish Agency for Marine and Water Management (SAMWM)[85] (waste in water), Swedish Transport Agency (waste in docks) and municipalities (waste in the local environment/local beaches). SEPA and SAMWM provide funding to SMRC.

Persuading businesses to start up in Sotenäs

A further challenge has been persuading businesses to start up in Sotenäs and, for them and already established businesses, to be able and willing to tolerate potentially fluctuating volumes of material e.g. polymers. "We are having successes with established businesses - for example with an interior design and building materials company, Out of Ocean, that was set up in Sotenäs, [86] but our main focus is supporting start-ups in an early development stage and attracting them to be based in Sotenäs as part of Symbioscentrum. For example, Impossible Plastics is in the process of setting up a facility in the municipality," says Peter.

Traceability – Track and Trace/Internet of Things (IoT)

"Traceability was another challenge, because, in the increasingly 'green' social climate, businesses and consumers alike are becoming more concerned about the genuine provenance of raw materials and finished products and demanding higher quality proof," Peter adds.

"We are addressing these issues through another Vinnova funded project we are running. It's based on IoT to help us develop a best of breed system of track and trace through tagging raw materials and auto-tracking them, end-to-end from the start of the supply chain to the point of manufacture.

"From the beginning we have had a simple system with name tags on materials in the different stages of the value chain (collecting, sorting, etc). The data related to the tags are then fed into an IT system. In the future we might use QR-codes and equipment, such as scales for weighing fishing nets, directly connected to the IT system.

"Provenance is all about proof of authenticity of origin. Traceability of fishing gear components used in manufactured products will be beneficial to all parties. What will result from this process is higher

[85] https://www.havochvatten.se/en/start.html
[86] outofocean.com

value components and a consumer base that has more confidence in the sector, for example, in what the sector says and claims," Peter says.

"To conclude, increasing demand by consumers for transparency and the facts about provenance are driving the need for higher quality traceability. IoT provides the means."

Extended Producer Responsibility (EPR)

EPR legislation will place responsibility on fishing gear producers for the financing, collection and recycling of "end of life" disposal of fishing gear. The system is an all-embracing recycling system including reporting to the agencies, collection, transportation and recycling, and in parallel a European standardisation process has started.

SMRC is already preparing for EPR rollout by the EU in 2025. Erik highlights that SMRC's experience will be useful in future EPR development. "We are involved in a project with SEPA and SAMWM which aims to involve different stakeholders that will be affected by the EPR to implement and test the system before it becomes legislation in 2024."

The main focus of this project is to test and develop the EPR system nationally, with one element also focusing on the standardisation process.

Standards

A new project on "design for circularity of fishing gear" has been set up at SMRC. It's led by CIT, working closely with NFA and SMRC. "Together, we are looking to create standards for how gear can be designed for circularity. Circularity, as it applies to fishing gear and beyond, is a key element of Symbioscentrum's ethos," says Peter.

"We are at an early stage in our thinking about standards, but we believe that standards will evolve at a European and Swedish national level. To that end, we are collaborating with Swedish Institute for Standards (SIS) and others as the project develops.

"Lessons learned at SMRC and TOW will be helpful for stakeholders in the fishing industry in Sweden, and across Europe and elsewhere, because EPR and circular design will force a rethink by all parties e.g. fishing gear designers, manufacturers, etc, about their post-sales responsibilities.

"Historically, fishing gear has not been designed to be easy to disassemble and/or recycle. Design for circularity overcomes the problem of the complex work and therefore time involved in separating the component parts of ghost and 'end of life' gear, and then reusing and/or recycling them."

Peter adds, "It is highly desirable to have gear that is designed specifically for easy disassembly, and with the parts easier to recycle. Historically, gear has used three different types of plastic where, today, just one type could in theory be used, making life easier for us and therefore product manufacturers."[87]

Erik comments, "Separately, SIS has set up a Swedish technical committee related to waste fishing gear that includes SMRC, and others, which means that SMRC is involved in forthcoming European standardisation work on 'Sustainable fisheries, aquaculture and fishing gear'" (CEN TC 466[88]). The technical committee's start-up meeting was in November 2021 which means that SMRC and other Swedish stakeholders will be engaged in future meetings.

Looking ahead

Unique salmon farm project

Sotenäs Symbioscentrum has been involved in talks that could see the world's largest land-based circular salmon farm[89] being set up in Sotenäs. The project backers chose Sotenäs for its location and because of Symbioscentrum's work with innovation, circular economy and industrial symbiosis.

The project's key circularity aspects are mainly related to water, energy and biomass, with plastics included but only being a relatively small part of the project.

Additionally, Sotenäs Symbioscentrum is currently part of two Horizon Europe bids - one focusing on ocean plastics and the industrial symbiosis more broadly.

[87] cfsd.org.uk/wp-content/uploads/2020/07/FINAL-V2-BCE-MASTER-CREATING-BUSINESS-OPPORTUNITIES-FROM-WASTE-FISHING-NETS-JULY-2020.pdf
[88] https://www.cencenelec.eu/news/brief_news/Pages/TN-2020-055.aspx
[89] https://www.seafoodsource.com/news/aquaculture/lighthouse-finance-s-roy-h-i-s-going-big-with-soten-s-ras-project

World Expo

SMRC is showcasing its work with marine plastics in the Swedish Pavilion at World Expo in Dubai World Expo (October 2021 to 31st March 2022).

Key conclusions: SMRC and its work

Local support and funding

The involvement of the local municipality, specifically in its funding, buy-in and political support was essential to establishing SMRC in Sotenäs. Funding from central government and the engagement from local organisations including NFA has also been key factors in SMRC development.

It is uncommon for a municipality in Sweden to become so involved in a project like SMRC, but its support has been vital to kick-start the project and keep the momentum going.

The role of external partners and companies

“Different projects require different partnerships with different expertise,” says Peter.

“Sotenäs Municipality is expert at collaboration, identifying potential projects and finding funding. Where specific skills are needed, the execution of a project is often carried out by one of the partners. Collaboration provides expertise, flexibility and ‘agility’ at lower cost or more cost effectively.

“The municipality collaborates with external partners because - as is typically the case with a municipality in Sweden - it doesn’t have all expertise in-house; and if it did, it would be at a high cost.”

The support of CIT and other academic partners that provided expertise and manpower has also been important to the project. The input and engagement by NFA has been essential to the development of SMRC and TOW as they have deep knowledge about fishing gear, its components and why different materials are used.

“Today, CIT supports the municipality with expertise in industrial symbiosis, circular economy, innovation management, logistics, resource mapping and analysis, etc” Peter comments.

Vision

In any project, it is important to have a vision, to help with direction and in establishing guiding principles.

Symbioscentrum's vision. To recap, when it started in 2015, Symbioscentrum stated that its vision was to develop a complete end-to-end system building on two anchor projects: a Rena hav biogas facility and waste water treatment plant; and the collection and recycling of ghost and "end of life" fishing gear (and plastic beach litter). The vision started with the recycling of fishing gear and has evolved to consider the circular design of nets and the creation of products from polymers from "end of life" and "ghost gear", and plastics recovered from beaches.

The NFA vision. As described earlier, a key player in the success of SMRC has been NFA. NFA developed a vision 15 years ago that incorporated sustainability in its working practices, when it recognised that it had to become more sustainable to survive. "Consequently," says Erik, "it began to see the benefits of using more selective fishing gear [90] and started to collect 'end of life' gear to prevent it from becoming 'ghost gear' – and to recycle rather than dump it in landfill."

NFA subsequently invested considerable time and expertise in recycling fishing gear. The founder, Sixten Söderberg, himself a fisher for 50 years and now Chairman of the Board of NFA, says fishers "should have a holistic view and not leave anything behind in the sea", adding:

"Sotenäs Marine Recycling Centre allows us to demonstrate to the fishing industry, in an informed way, the benefits of picking up all the nets and all the rubbish dropped into the sea and the importance of keeping the seas clean and the fish healthy."[91]

NFA's interests and activities fit in well with the vision and ethos of SMRC and its testbed, where TOW is playing a lead role in the new project aimed at the designing fishing gear to be more circular.

[90] Selective fishing gear is a process that has been developed and used by NFA to reduces by-catch and the 'wrong' catch by using parts in their nets that let unwanted fish out. It also allows fishers to capture only the size of catch they want. slu.se/en/departments/aquatic-resources1/selective-fishing/

[91] symbioscentrum.se/projekt/marinatervinningscentral.4.72c6ff61174737cf53eddbb6.html

As stated earlier, the SMRC vision is to be a flagship for innovation and knowledge for ocean plastics and fishing gear that works with the whole value chain from design, collection and recycling to the development of new “circular products”. This to be achieved through:

- Creating and developing a value chain related to polymers and other materials arising from waste and “end of life” fishing gear
- Creating a world class research centre lab for ocean plastic waste in Sotenäs, e.g. to be a “centre of excellence” for research, development and networking related to ocean plastics
- Acting as a testbed for sorting and recycling of fishing gear
- Contributing to the development of standards development relevant to EPR and the circular design of fishing gear
- Having a digital twin of the facility, through creating transparent tracking of the entire system via IoT
- Sharing the model with other countries to help: (i) increase the reuse and recycling of ocean plastic, (ii) increase value of the materials, and (iii) help clean the oceans globally by working “glocally” – working globally and locally

There must be no cost to fishers

If there is a cost to fishers, they will not be interested in participating.

Project development

Since SMRC was founded, several projects of different sizes have been carried out that contributed to its development. Some of these have been funded through EU funded Interreg projects, Swedish government innovation projects and other financial support programmes as well as regional and locally financed projects. The ability to join up the separate, individual projects and build on the knowledge and learning, has helped SMRC move forward despite a lack of strategic core funding.

Best practice

SMRC is developing examples of best practice related to the recycling of fishing gear that includes collection, sorting, circular design and testbed development. The goal is to share knowledge and experience in Sweden, Europe and/or the rest of world particularly related to: (i) test methodologies e.g. the use testing of a different types of polymers for possible use in the manufacture of new

products, (ii) technology methodologies e.g. manufacturing methodologies, and (iii) sharing of the findings of how to set up and manage a fishing gear recycling system with interested parties.

Endnote: Key lessons learnt and insights

There have been two key learnings from SMRC that have been crucial for its development:

- Gaining the local political will from Sotenäs Municipality to invest in SMRC and related initiatives
- Getting fishers' and volunteer marine waste collection groups' buy-in to the project. Fishers, via NFA, have been highly instrumental in the success to date of SMRC. The success includes the creation - driven by SMRC - of regional hubs throughout Sweden that feed "end of life" fishing gear and ghost gear to the centre.

SMRC is unique in Sweden and potentially unique in Europe and the world.

SMRC aims to:

- Develop a model, aligned to its vision - that could be duplicated elsewhere in the world - for an end-to-end, closed loop system starting with circular designed fishing gear, locally-based manufacturing and services and, related, work experience, training and job creation
- Act as a magnet for new businesses that align to the goals of Sotenäs Symbioscentrum, in which SMRC is playing the leading role related to waste fishing gear
- Share best practice, knowledge and information, in order to help accelerate change in fishing gear recycling and circular economy thinking elsewhere
- Engage in standards development related to the recycling and circular design of fishing gear e.g. that aims to increase the speed and ease of disassembly and improved recyclability. SMRC is now involved in providing inputs into European standards development in relation to EPR legislation that will impact on the fishing industry in Europe starting in 2025

ANNEX 2: STEVESTON HARBOUR: A CASE STUDY ON FISHING GEAR RECYCLING IN CANADA

Background

This case study is based on an interview and correspondence with Joel Baziuk, Associate Director, Global Ghost Gear Initiative (GGGI)[92] at Ocean Conservancy.[93] The interview[94] focused on Joel's experience of leading the establishment and organisation of a recycling programme for "end of life" and discarded fishing nets in Steveston Harbour, British Columbia (B.C.), Canada, when he was employed as Operations Supervisor by Steveston Harbour Authority (SHA).[95]

The programme was started in 2014 and is now managed by SHA Operations and Security Manager, Glenn Chow, who also provided further information for the case study. Joel moved to GGGI in the summer of 2017. The programme paused in 2017 as there was no buyer for the nylon nets. Fishing gear recycling re-started in 2018 when Glenn Chow located a local buyer for the nylon nets.

Introduction

With more than 45 acres of upland and 25 acres of shoreline, Steveston Harbour is the largest small craft commercial fishing harbour in Canada. Species fished locally include salmon (sockeye, chinook, pink, chum, coho), shrimp, Dungeness crab, urchins, black cod (sablefish), rock fish (several varieties), halibut, herring, hake, spot prawns and sardines.

The fishing gear recycling programme in Steveston Harbour is located in Richmond, just south of Vancouver. The initiative was established to find ways of disposing of piles of "end of life" nets that had been accumulating in the harbour and which previously had to be sent to a landfill or incinerated because there were no other waste management options at that time.

[92] https://www.ghostgear.org/ The GGGI was founded by World Animal Protection in 2015 and has been hosted by Ocean Conservancy – a long-time leader in the marine debris space – since January 2019. The GGGI is the only cross-sectoral alliance driving solutions to the problem of ghost gear worldwide. It is also the lead platform under which the global community can unite to improve the health and productivity of the ocean, protect marine life from harm, and safeguard human health and livelihoods. The GGGI's work is focused on ghost gear, but also directly impacts the issues of marine plastics and global food security. The GGGI currently has 125 member organisations and is supported by 18 governments.
[93] https://oceanconservancy.org/
[94] Conducted on 3rd March 2021
[95] The Steveston Harbour Authority (SHA) was established in 1990 as a non-profit organisation which leases Steveston Harbour and its facilities from the department of Fisheries and Oceans Small Craft Harbours Branch (DFO - SCHB) with the mandate to operate and maintain the facility as a commercial fishing harbour

The most relevant gear types related to the recycling project were salmon gillnets, and salmon and herring seine nets, along with some trawl gear.[96] A large volume of fishing nets and gear – predominantly nets - had been stored in harbour areas, after a move to a quota system for fishing licences that had been launched decades earlier. In the quota system, each licence had a set amount of fish the licence owner was permitted to catch (the quota).

However, licence owners could either choose to fish their own quota or lease their quota for a fee to other fishers, who could then fish additional quota(s) on their vessels, increasing their allowable catch. As a result, multiple quotas of catch were often stacked on a single vessel which would go out to fish, meaning fewer vessels – and thus fewer nets – were being used.

“Many of these nets had been sitting - in some cases for decades - unused and deteriorating due to ultraviolet (UV) light from the sun breaking them down once the tarps[97] that had covered them fell apart after years of being out in the elements,” says Joel. “The only viable ‘end of life’ solutions, then, were burial in a landfill or incineration, both of which carried a cost to the harbour.

“As most harbour authorities in B.C - including Steveston - are private, non-profit entities under the Harbour Authority Programme, the costs of disposal to landfill was ultimately borne by the fishers in the form of increased moorage fees. That is unsustainable from both an economic and environmental perspective. A new solution was needed.”

SHA wanted to explore a local recycling operation but there were no fishing net recycling providers locally at the time. Inspired by Net-Works[98] fishing net recycling programme in the Philippines, SHA decided to reach out to the organisers of that programme to see what it would take to implement a similar programme in Canada.

---

[96] (i) Bottom trawling is a fishing practice that herds and captures the target species, like ground fish or crabs, by towing a net along the ocean floor (ii) Trawl nets are funnel shaped nets with extended wings at the opening that are towed by a vessel. Trawl nets are responsible for the greatest portion of the nation's fish and shrimp catches.

[97] Tarps is a short name for tarpaulins

[98] https://net-works.com/ Net-Works is a successful fishing net recycling programme which began in the Philippines run in partnership with the Zoological Society of London, Interface (one of the world’s leading carpet tile manufacturers) and Aquafil (the world’s pre-eminent nylon recycler). The nylon is sent to Aquafil to produce Econyl that, in part, goes into carpet tiles and carpets of a specific brand name. InterfaceFLOR is a carpet tile and commercial flooring company based in Atlanta, USA, with manufacturing facilities in Australia, China, the Netherlands, Thailand, the UK and the US who have a range of tiles and carpets are made from 100% recycled content including nylon from “end of life” and ghost fishing gear. More at https://net-works.com/press-releases/net-works-the-worlds-first-inclusive-business-model-to-recycle-discarded-fishing-nets-made-in-the-philippines-and-now-primed-to-go-global/

Through that initial outreach, SHA made contact with Aquafil, one of the partners of Net-Works. Aquafil has played a major role in the Net-Works programme by turning waste nets into nylon for use in the manufacture of carpet tiles by Interface.

“We decided to emulate what Aquafil was doing for Net-Works. The company was a clear choice for us,” says Joel. “It was long-established, experienced in the production of ‘second life economy’ fibres from nylon fishing nets and interested in receiving the nylon nets from Steveston Harbour.”

Following discussions, Aquafil’s proprietary chemical recycling process that was based on depolymerisation/repolymerisation of PA[99] (specifically PA6[100]) was selected as the ideal process to convert waste nylon from fishing nets in Steveston to a second life fibre.

The pilot

As a starting point, a pilot programme was set up in 2014 which focused on identifying the specific polymers used in the nets in Steveston. The results indicated that the seine net body web and the gillnets were polyamide e.g. nylon (PA6 specifically) and the seine border web/bunt and trawl nets were polyethylene (PE[101]), with some polypropylene[102] (PP) ropes).[103]

The purpose of the pilot was to provide a sustainable alternative to disposal of “end of life” fishing nets in Steveston Harbour. Landfill disposal was expensive, particularly since disposal of fishing nets required special burial permits as they could not be put in the regular waste stream.

The pilot was developed to save the harbour (and thus the fishers) money in disposal costs while ensuring the material was recycled and put back into the value chain rather than discarded. It began with a site visit from Aquafil to use a computer analyser and hot probe device to identify the specific polymers of the various kinds of fishing nets and ropes found in the harbour. The initial analysis indicated that approximately 50% of the fishing nets in Steveston Harbour were PA6 (nylon), with the remainder being a mix of either PE or PP.

[99] PA: Nylon plastic/nylon polymer.
[100] PA6, also known as Nylon 6, is a polymer that has the properties of nylon 6.6 without violating the patent on its production.
[101] The most widely used plastic in the world https://www.britannica.com/science/polyethylene .
[102] Similar to polyethylene, but it is more heat resistant and slightly harder.
[103] The polymer composition of the types of fishing nets used in Steveston is as follows (percentages are approximate): seine nets: ~50% PA6, 50% PE with rare occurrences of PA66; gill nets: 100% PA6; and of trawl nets: 100% PE.

Aquafil's depolymerisation/repolymerisation process only uses PA6 as a "feedstock" to produce its proprietary Econyl second life fibre and therefore PA6 nets were used for the pilot. SHA staff separated the PA6 (which is found mostly in the body web of seine nets and most gillnets) from the fishing nets and bagged it using large used grain sacks from the agriculture industry provided by Aquafil.

When the first load of approximately 14,000 kg of PA6 was collected and ready for transportation, Aquafil sent a shipping container to the harbour via a semi-truck, into which SHA staff loaded the bags of PA6 fishing nets. In late 2014, the PA6 was loaded into semi-trucks at Steveston Harbour and taken to the Port of Vancouver where it was loaded onto a container ship and sent to Aquafil's recycling facility in Slovenia.

On receipt, the PA6 sent by SHA to Aquafil was tested and found to be 98% pure. Aquafil then paid SHA an agreed price per kg, which was used to cover the costs to prepare, strip and transport the fishing nets for recycling. The success of the pilot programme led to a long-term partnership agreement to send more material to Aquafil as and when it could be stripped, sorted and bagged to meet minimum volume requirements for shipping.

After that initial pilot, fishers - instead of SHA maintenance staff - were paid to do the stripping and bagging of the nets, paid out of the fees Aquafil paid for the material. Between 2014-2017, approximately 60,000 kg of PA6 (fishing nets) was sent to Aquafil.

In 2017, a load of PE/PP material was also sent to Denmark's Plastix Global as a trial, due to Aquafil being unable to recycle polymers other than PA6. Although the materials were found to be pure, the volume of material that could be placed in a container was less than that of the PA6 fishing nets which, coupled with the lower market value of PE/PP as compared to PA6, made this programme economically unsustainable.

As a result, with no local recycling option available at the time, the trial ended and PE/PP material continued to pile up as a by-product of the collection programme, mostly due to approximately 50% of a typical seine fishing net being made of PA6 and the other 50% being PE.

Consequently, the PE/PP fishing nets had to be sent to a landfill to free up storage space to allow the programme to continue. The programme restarted in 2018 when Glenn Chow located a local buyer for the nylon fishing nets.

In 2020, it paused again for reasons stated below. In July 2021, SHA welcomed a new tenant to its site: a local recycler Ocean Legacy Foundation[104] (OLF) which was able to recycle both PE and PP material. OLF will be able to start recycling PE and PP nets in mid-2022 when its new equipment is installed. Currently SHA is sending PP ropes to OLF for recycling. In 2023 OLF may be able to process PA (subject to funding approval from the federal government). In the meantime, SHA is searching for an alternative buyer for the nylon to free up warehouse space so that it can continue to strip "end of life" fishing nets.

Challenges of the SHA programme and similar programmes

Continuity of source of raw materials for "end of life" fishing gear

When large volumes of the fishing gear have left a primary hub, in this case Steveston Harbour, after being stored to maximise the volume being "shipped" at any one time to a recycler, there might be nothing else in the supply chain for weeks or months. "That is not good for any element of the supply chain including recycling centres unless they are educated about it and accept its potential drawbacks," Joel points out.

Where primary hubs store the "end of life" fishing nets to create a single large volume rather than shipping - less cost-effectively - smaller volumes, price fluctuations can then become another issue for recyclers. The recyclers, in addition to typically wanting some guarantee on, or indications of, volume regularity, might therefore face price fluctuations resulting from any extended storage of fishing nets at the primary hubs.

"Some extended storage of material might happen for price reasons alone, with a primary hub waiting for prices to rise during periods of low market prices. This was certainly the case in Steveston during the Covid-19 crisis of 2020/2021 which saw nylon prices decline significantly, so SHA had to store

[104] https://oceanlegacy.ca/

the material waiting for prices to rise again enough to make recycling economically viable," says Joel.

Getting recyclers interested

"Currently, SHA is trying to figure out how to get more recyclers in British Columbia (B.C.) involved, because keeping things local has to be preferable to shipping gear from one continent to another. Transporting it to Slovenia obviously creates a greater CO2 footprint than keeping it local. But again, the point of the pilot with Aquafil was to demonstrate it could be done and that there was a commercial value to the material. And SHA hoped it would spark the implementation of a local facility that could process the material," highlighted Joel.

Not all recycling centres are equipped or designed to handle fishing nets. "Nets can be huge - and are of course designed for catching fin or shellfish, which can be a problem for recyclers because the nets can easily get snagged in a centre's equipment. Where recyclers are unable to process nets they tend to shred them prior, for example, to producing pellets for use by manufacturers," Joel states

If fishing nets can't be shredded prior to shipping, they will typically be shredded upon arrival at the recycling facility.

Joel highlights, "Shredding is done to either compress volume of material for maximising shipping efficiency, or to make the material easier to put into the extruders for the production of pellets. It's much easier to put shredded material into an extruder than trying to put actual netting into it.

"If nets can't be shredded prior to shipping, they will typically be shredded upon arrival at the recycling facility. Most recycling facilities have their own shredders to shred nets before putting them into their equipment to do the melting and extrusion or whatever processing needs to be done to turn them into pellets. I don't know if Aquafil shreds them or not prior to their process.

"Where there are no local recyclers equipped to handle nets, the answer is to use local fishers to take nets apart and pay them for doing so. Those payments can be partially offset by income generated through selling the component parts to recycling centres. Working with the fishers to strip the nets is necessary whether the recycler is local or not, for example, to ensure that only the material(s) the recycler can handle is actually shipped to them."

On the subject of income for fishers (and SHA) Joel states, “Pricing for the material we sent to Aquafil fluctuated, but I recall it typically being around $.50 – 0.60 USD/kg or thereabouts. A typical load of 18,000 kg would on average result in about $10,000 USD to SHA, which would pay fishers about $4,500 USD for stripping, separating and bagging the nets and pay $4,500 USD for the preparation, logistics, transportation and overseas shipping costs to send the material to Aquafil. Typically there was a flat rate per shipping container regardless of weight, so it was economically better to load as much material into a container as possible.

“It was never intended to be a money-making venture, but so long as it was at least cost-neutral, which it always was, it worked - and saved the harbour having to pay for landfill disposal fees to bury the nets, so everyone won in the end.”

Fishers completed the stripping and bagging of the fishing nets to earn some additional income because “Nobody can strip a net better than fishers,” Joel says. “They can do it much more efficiently than anybody else. They have worked with nets for their entire lives.

“It was a good way to provide additional income to fishers in the off-season,” he adds. “Fishers continued to be paid out of the money the harbour received from Aquafil for the nets, keeping the programme cost-neutral - or better - for the duration of the first phase between 2014-2017. Because the fishers did the stripping in the off-season, they earned more money than fishing at that time. SHA worked around their schedules.”

To emphasise, the long-term goal of the SHA fishing net recycling programme was always to prove the concept that recycling nets could be economically feasible and ultimately establish a recycling facility that could handle the material locally.

In 2018, SHA made contact with Save Our Planet (SOP) Richmond Recycling Inc, which provided a local solution to shredding and recycling services for PA and PP fishing gear. Using a local recycler delivered a range of benefits including reduced shipping fees and eliminated requirements to deal with customs and other onerous paperwork. This worked for a couple of years and SHA sent over 60,000 kg of raw stripped materials for recycling.

In March 2020, SHA had to stop sending fishing nets to SOP for recycling for two reasons: (i) the company was no longer able to pay an effective market rate for the material, partially due to Covid-19 interrupting global supply chains and market prices, and (ii) because it needed to upgrade its

equipment as the fishing nets were consistently getting tangled in the shredder and causing breakdowns.

And to recap, Joel assisted SHA in looking for a replacement recycler and identified OLF, which will soon be able to handle PE and PP fishing gear (starting in March 2022). OLF plans to also be able to recycle PA by 2023, pending government funding for additional equipment.

"Ghost gear"

"Ghost gear"[105] has a proved challenge because of the time and cost involved in retrieving and processing it. Therefore, the main focus of the recycling programme has been on retrieving, processing and recycling "end of life" fishing gear.

However, a pilot project to assess the viability of recycling "ghost gear" as part of the programme was carried out in 2016 following a GGGI recovery of a seine net near Pender Island, B.C.[106] "Although the results were promising, a then lack of large-scale 'ghost gear' retrievals, and the challenges related to cleaning recovered ghost gear for recycling, meant that focusing on 'end of life' gear was by far the more sustainable way forward," states Joel.

"'End of life' gear includes very large nets which, have historically been buried in landfill or incinerated. As a reference, a large seine fishing net used for catching salmon or herring, can weigh approximately 9,000 kg and could roughly cover an American football field in area when stretched out. Of this, approximately 60% of the fishing net would be PA and the remainder PE border web and bunt.

"Where they exist, programmes like SHA's tend to be primarily focused on 'end of life' rather than 'ghost gear' because of the larger volumes involved, and because recovering 'ghost gear' takes much more time, effort and expense. It also has to be cleaned sufficiently before it can be recycled, which takes additional time and effort and, of course, cost," Joel adds.

In contrast, cleaning "end of life" gear is a different matter. "The nets coming into the programme are mainly at "end of life" and were well-maintained prior to arriving, so cleaning is generally not needed."

[105] https://www.worldwildlife.org/stories/ghost-fishing-gear
[106] https://www.youtube.com/watch?v=YG7J3sFt_g0

However, retrieving “ghost gear” around B.C. has not been completely overlooked. The Emerald Sea Protection Society[107] and Coastal Restoration Society[108] – both GGGI members – have been actively retrieving gear in B.C. for some time; and the crab fishers in Northern B.C. have carried out annual crab pot removals for several years. In addition, a programme run by Department of Fisheries and Oceans (DFO) Canada - a Canadian federal agency responsible for sustainable use of waterways and aquatic resources in Canada - works with local indigenous groups along the Fraser River to remove “ghost gear” there.

Advances are being made in preventing fishing gear from becoming “ghost gear”. For example, Blue Ocean Gear, has developed smart buoy and gear tracking technology that identifies and locates “ghost gear” in real time.[109]

Lessons learned

SHA established a fishing net recycling programme that has proven itself successful over many years, despite occasional challenges. There are ambitions to expand the programme further in B.C. while greatly reducing the transcontinental transport of waste fishing gear in its “raw”, or shredded or pelleted state. The points below set out general principles and lessons learned from the SHA fishing net recycling programme that can be applied anywhere in the world within a local or regional context.

Don’t charge fishers

“It’s critical for fishers not to be charged anything at any time,” says Joel. “That helped us get their buy-in and will help to get the buy-in of fishers in similar schemes. It typically takes just one or two influential fishers in an area to buy in and get other fishers involved.”

In a programme in Alaska, Net Your Problem[110] asks (i) fishers to pay for their old fishing nets to be taken away and processed and (ii) recycling operations to pay for the raw source. Although for-profit models like that of Net Your Problem have found success in remote regions with few or no other

[107] www.emeraldsesociety.ca
[108] www.coastalrestore.ca
[109] https://blueoceangear.com/
[110] https://www.netyourproblem.com/

options for fishing net disposal, the long-term viability of models where fishers have to pay (fisher-pays models) is very uncertain.

“It’s key to engage with fishers and involve them in fishing net disassembly - and pay them - not just in gathering nets together at a primary or smaller hub. At present, the SHA recycling team consists of one co-ordinator and two strippers. To repeat, nobody can strip a fishing net better than fishers,” Joel says.

“Most fishers reuse and patch nets up in the course of normal operations anyway, meaning they are very familiar with them and their component parts, not just as a means of fishing. Nets designed for easier dismantling and using single polymers would make it even easier for them and recyclers.”

Fishing gear designed for easy disassembly would help to improve the economic margins of recycling programmes as it would cut down on labour costs and allow more nets to be processed more quickly.

“It’s key to demonstrate to fishers in any scheme that there is ‘added value’ for them with, for example, ‘what’s in it for me?’ Income from disassembling nets is a clear ‘value add’,” says Joel.

Another concern is lead in lead line, used to weigh down the bottom of seine and gillnets so they stand vertical in the water column. Lead has some value for metal recyclers, but it is difficult or impossible to separate from the rope that surrounds the lead core. However, lead line can be reused in new or refurbished gear. “That’s a definite advantage that fishers can see in fishing gear recovery programmes,” says Joel.

Another “value add” came from SHA arranging for waste gear that’s suitable for reuse to be put into bins at ports, where fishers would pick it up free or charge or at low cost. “Buy-in from fishers and, where applicable, fishing associations, is another important starting point,” he adds.

SHA also recycles the brass and aluminium rings, ropes, cork line, lead line, floats, buoys and other peripherals that are stripped from seine nets. The ropes are put in a tote box at the front gate of the harbour and fishers and anyone else who wants them may take them for free. Since 2018, the brass rings, aluminium rings, lead line, corks and buoys were all sold back to fishers at discounted prices. The money SHA received from the sale of these items went towards paying fishers for stripping the nets. Very little material goes to landfill.

Have the facilities in place

Any primary hub - Steveston Harbour is the example in B.C. - must have all the appropriate facilities. Having shredders on site is potentially an asset, but they are generally not necessary, as most recyclers will have shredding equipment of their own.

“A primary hub need not have a particularly complex operation, but it does require a sizeable area of land as well as facilities and equipment,” Joel points out. “Steveston Harbour has the land and facilities including a covered net repair facility to strip the nets, covered storage areas, forklifts and heavy equipment to move the nets, and 12 or so full-time staff and multiple part time staff members to draw on.

“Having all the facilities and associated logistics in a secondary hub such as a smaller or remote harbour is more difficult. For example, local roads in remote areas might be inadequate for use by the large trailers needed to move volumes of ‘raw’ or processed gear. Others might only be accessible by water or at certain tides, etc. Storage in smaller ports especially is a problem in many parts of the world simply because there typically isn’t much space for it. Where there is, it’s typically a revenue generator for the port by charging fishers to store usable fishing gear, for example.

“It’s more feasible for secondary hubs to supply primary hubs with ‘end of life’ gear, transported by road or sea, rather than to try to handle and process it all themselves with their own facilities, which in many cases are lacking or non-existent. This sort of distribution - from secondary to a primary hub and then to a recycler - is key for the viability of gear recovery schemes across large geographies which wish to include smaller harbours/communities.

“In secondary hubs, what may be needed after storing ‘end of life’ fishing gear is a visit by a truck or trailer or boat every few months to collect the fishing gear and bring it to a larger centre, but the transport and logistics need to be funded from somewhere.

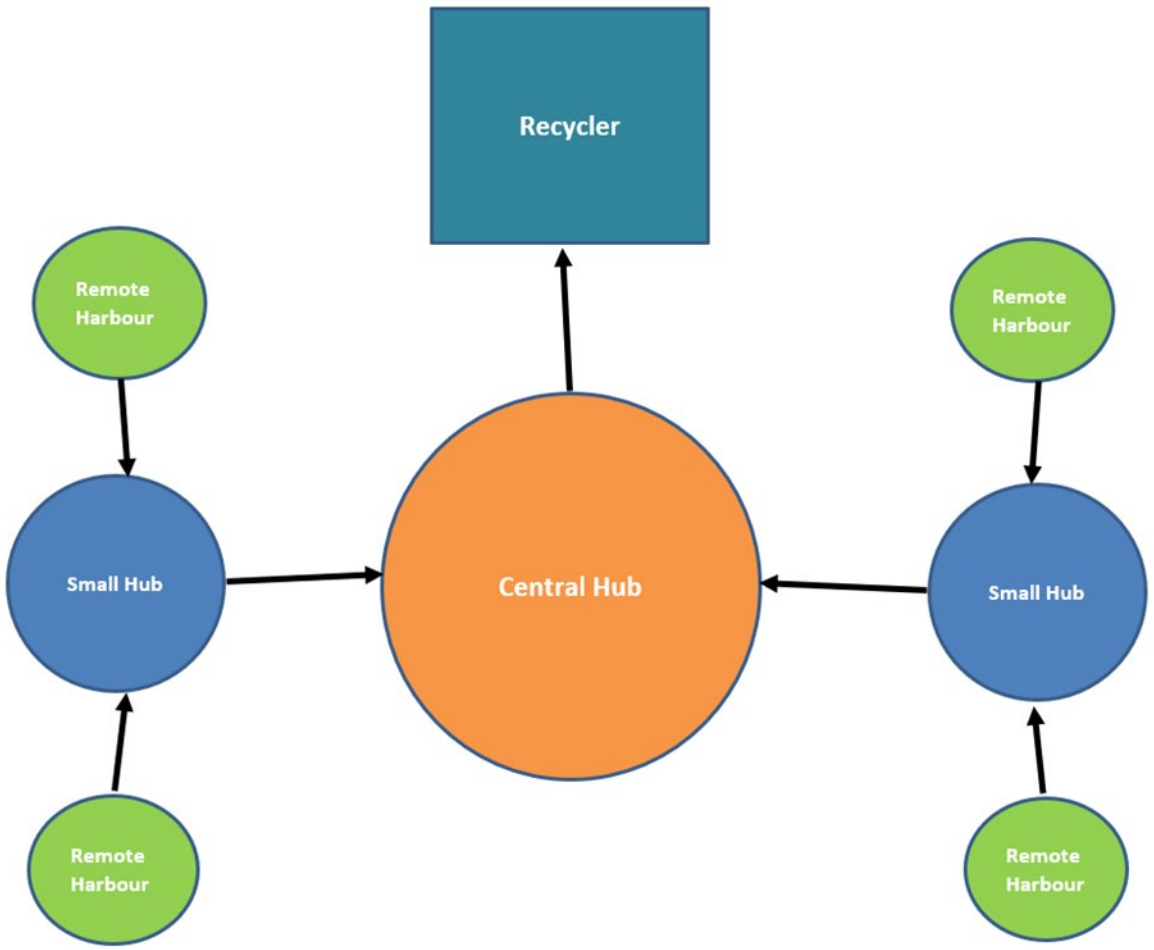
“The programme in Steveston works because it’s central and has everything it needs to implement the programme. As soon as you’re talking about collecting and transporting comparatively small amounts of material from smaller secondary hubs, the game changes and additional funding is needed to support it,” Joel states, adding:

“Things are changing. Two large ports in B.C. have been identified as possible primary hubs and have said they are willing to participate - even if only as locations for accepting fishing nets from

smaller communities and then sending them on to Steveston to be incorporated into the recycling programme there."

The identified ports are Port Edward Harbour Authority in Prince Rupert and the Port of Port Alberni in central Vancouver Island. Between them they would create a northern primary hub (Prince Rupert) and a central primary hub (Port Alberni located in the centre of Vancouver Island). Like Steveston Harbour, they have adequate facilities to store fishing nets coming in from small ports in their respective regions and have access to international shipping ports if water transport is deemed the most efficient way to move gear.

Figure 7: Primary and Secondary Hub Model



Different ports will have different ways of doing things; that is, they will have different "cultures", where "culture" means "the way we do things around here". That extends to how they get around

limitations presented by inadequate infrastructure including narrow roads, meaning fishing gear could be shipped by sea to a larger port/hub, in B.C.'s case Steveston Harbour.

Think "commercial"

Get a commercial partner - a customer - on board early on to take waste fishing gear to at least break-even over a set period. At Steveston Harbour the early partner was Aquafil.

Be aware of the economics of a scheme and any immature infrastructure

The example earlier in this case study - of a recycler local to Steveston Harbour being no longer able to pay SHA an effective market rate for fishing gear - demonstrates the potential economic and immature infrastructure pitfalls facing a primary hub as it develops.

The lesson learnt is to build awareness into a business or project plan that some setbacks might occur, with the proviso that resources will be available to resolve issues as and when they arise. The resources can be in-house or external, or, as with SHA, a combination of in-house and external.

Agree on regularity and volume of supply, where possible

Ensure a regular supply of fishing nets or components to recyclers, with peaks and troughs smoothed out if possible, unless recyclers are happy to accept irregular shipments and varying volumes.

Think local - but global in the short term at least!

SHA started global with a customer – Aquafil – in Europe as there was no other choice at the time. Starting small is not a problem. Launching a pilot programme to learn what works and what doesn't in any specific context is a good way to start. This can demonstrate there is a value to the material and a pathway to have it recycled, even if it's not in-country. This was essential to get initial buy-in from fishers, the harbour and others in Steveston's case. If there is a local option, however, then that's always the best way to go both from a carbon footprint perspective as well as an economic and logistical one.

"Where there's a desire to see a programme like this created, it can be done", Joel emphasises.

ANNEX 3: STAKEHOLDERS THAT WERE IDENTIFIED AS HAVING A POTENTIAL INTEREST IN THE WASTE FISHING GEAR IN THE ÅLESUND REGION

At the Ålesund workshop delegates were asked to identify stakeholders that might have a direct or indirect interest in waste and “end of life” fishing gear in the Business and Innovation Sub-system, and the Fishing Sub-system in Greater Ålesund area. These stakeholders have then been classified by type. It is recommended that there should be further mapping of stakeholders related to the value chain and networks associated with waste and “end of life” fishing gear in the Greater Ålesund area.

Stakeholders: Business and Innovation Sub-system in Ålesund

Waste Management Companies

- Årim (Household waste management) arim.no
- Bingsa (Landfill operator) – part of Årim arim.no
- Tafjord (Incineration and hydro power group)
- Viking (Boat demolition and logistics -> nets and ropes to Noprec)
- Nofir (Logistics) fishing gearnofir.no
- Sunn-trans (Waste Management)
- INorsk Gjennvinning norskgjenvinning.no

Recycling

- Noprec noprec.no

Plastics producers

- Sundolitt (EPS)
- Vartdal Plast (EPS)
- Pla-Mek pla-mek.no

Fishing Gear Producers

- Selstad
- Mørenot
- Mustad

- Frøystad
- Fiskevegn

Research and innovation

- NTNU - Norwegian University of Science and Technology
- Møreforskning (Regional Research Institution)
- Kunstfagskole (Art College)
- Blue Maritime Cluster
- LD Hub
- Startup Norway
- ÅKP (Consultancy)
- Innovasjon Norge (state-owned innovation agency and a national development bank).
- Pir Invest
- Mo Industrial Park (MIP)
- Norwegian Maritime Competence Centre (NMCC)

Sectors

- Plastic Manufacturers
- Plasto

Business - general

- Ekornes (a manufacturer of sofas and chairs) (Pla-Mek customer)
- Jacu (Coffee roaster)

Other

- Subsea 7 (subsea engineering, construction and services company) industry)
- Smart City Lab
- Kystverket (Coast Guard)
- Vik Ørsta (Pla-Mek customer)
- Noprec
- Replast (supplier of pellets to Pla-Mek)

Stakeholders: Finfish and shellfish sub-systems in Ålesund

Associations

- Fiskebåt rederia (Fishing boat owners association)
- Rederier (Shipowners association)
- Norges Kyst Fiskarlag (Coastal Fisherman Association)
- Fiskebåt (Advisory association for fishers)
- Fiskerlaget (Norwegian Fishermen Association)

Fishers (primarily family or sole owners of fishing boats)

- Havstrand
- Fiskerskjer
- Geir
- Seir
- Strand Senior
- Atlantic Star
- Atlantic Viking
- Granit AS
- Strand Rederi (Fishing boat and freezing)

Seafood

- Marine Harvest (global seafood company)
- Lerøy (Fish processing/transport)
- Normarine (Fish Processing)
- Fiskemottak (Seafood processing)

Aquaculture

- Mowi (Salmon Aquaculture)
- Brimer (Manufacturer of tanks made from composite materials for reservoirs, fish farming or storage).
- Salmar (Salmon aquaculture)

Other

- Fiskerkompetanse (Maritime Management Company)
- Harbours
- Volstad Maritime (owns vessels that operate in seismic exploration)

ANNEX 4: STAKEHOLDERS THAT WERE IDENTIFIED AS HAVING A POTENTIAL INTEREST IN THE WASTE FISHING GEAR IN THE GALWAY REGION

At the Galway workshop delegates were asked to identify stakeholders that might have a direct or indirect interest in waste and “end of life” fishing gear in the Business and Innovation Sub-system, and the Fishing Sub-system in Greater Galway area. These stakeholders have then been classified by type. It is recommended that there should be further mapping of stakeholders related to the value chain and networks associated with waste and “end of life” fishing gear in the Greater Galway area.

Stakeholders: Business and Innovation Sub-System in Galway

Waste management companies

- Walsh Waste (Contractor) walshwaste.com
- Flannery Nagel (Consultants)

Recycling

- Waste Matters Recycling
- Walsh Waste
- Speeco Material Synopsis
- Aquafact (Consultant)
- Gammon Construction (includes recycling) gammonconstruction.com

Fishing gear producers

- Swan Gundry Nets

Research and innovation

- Marine Institute (Research). marine.ie
- Galway Institute of Technology (GMIT) (Research Centres) gmit.ie
- GMIT Innovation Hub
- NUIG (Ryan Institute) – Researchnuigalway.ie/

Sectors

- Producers of Plastics
- JFC Groupe jfcgroup.ie/sectors/marine/

Local government and development agencies

- DAFM
- County Councils
- WDC (Creative Industries/artists network (Donegal)) wdc-creative.com
- Smart Bay (Ireland's National observation and validation facility for the marine and ocean energy sectors).
- Údarás na Gaeltachta (regional agency for Irish speaking regions of Ireland) udaras.ie/en

Business – general

- Halo Business Angel Network (business angel network) ban.org
- Portershed (coworking office space for entrepreneurs)
- Gannet Marine (supplies clothes and fishing tackle) gannetmarine.ie
- Maeve Thornberry Associates (Consultant) maevethornberry.ie

Others

- Letterfrack Sea week (Irish Sea Week festival).
- SeaFest (Ireland's national maritime festival
- Connemara Mussel Festival
- Spidle/Spiddal Artists Hub
- Malo
- Atlantic Equipment http://www.atlanticequipmentproject.com/
- SmartNet
- Sea Synergy (project related waste fishing nets) seasynergy.org

Stakeholders: Finfish and shellfish sub-systems in Galway

Harbours, Ports, etc

- DAFM

- Rossport Harbour Centre

Associations

- Galway inshore fishing association
- Marine Institute
- The Irish South & West Fish Producers Organisation Limited

Fishers

- White Fishing Fleet
- Oysters – various companies
- Galway & Arran Fishing Co-op
- Non co-op vessels, non IE vessels based in Galway
- Independent Fishers (Pots, reels)

Seafood

- Bord Iascaigh Mhara (BIM) (Government agency that supports seafood industry).
- Galway Bay Sea Foods galwaybayseafoods.com
- Carr & Sons Seafood
- Connemara Shellfish
- MMT/SPG (Fish processor)
- ISPG (Irish Seafood Producers Group)
- North Western Fisheries Co-op

Aquaculture

- IFA aquaculture
- Marine Havant
- MOWI – organic salmon farming
- Regional in shore fisheries forums
- National in shore fisheries forums

NGOs

- Clean waste groups – Deltich
- Clean Coast
- Fishing for litter

Others

- Leader
- Flag
- Tidy Towns
- Community sector

BACK PAGE

The Centre for Sustainable Design ®, Business School for the Creative Industries, University for the Creative Arts, UK

The Centre for Sustainable Design ® (CfSD) was established in 1995 in Farnham, Surrey, UK at what is now the University for the Creative Arts (UCA). CfSD is based within the Business School for the Creative Industries (BSCI). The Centre has led and participated in a range of high-quality research projects and has organised hundreds of conferences, workshops and training courses in Europe, Asia and North America focused on sustainable innovation and product sustainability. CfSD is recognised worldwide for its knowledge and expertise, having worked closely with business, policy making and research communities for two decades. CfSD has built world-class knowledge and expertise of sustainable innovation and product sustainability. The Centre completes research and disseminates understanding of present and future sustainability impacts and solutions related to innovation, products, technologies, services and systems through projects, training, events, networks and information. CfSD works with partners in Europe, Asia and North America to deliver high quality results. CfSD have led and partnered in 15+ European Commission funded projects (www.cfsd.org.uk/projects) and has actively worked with 500+ eco-innovative SMEs. The Centre is an internationally recognised centre of excellence. CfSD has two areas of core competence based on extensive research since the mid-1990s (www.cfsd.org.uk/research). CfSD integrates Circular Economy into its broader sustainable innovation and product sustainability activities http://cfsd.org.uk/news/circular-economy-innovation/

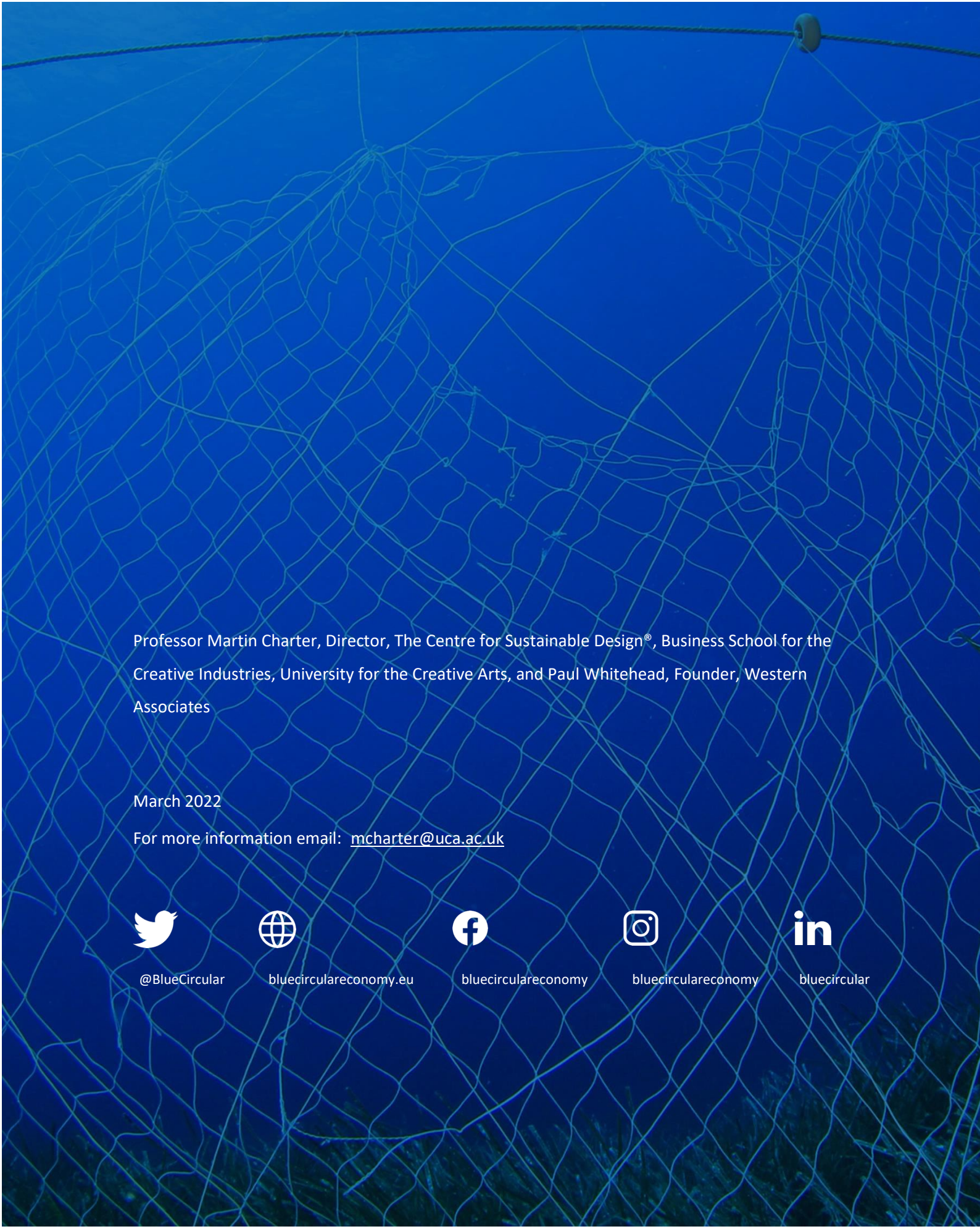
- Sustainable Innovation (Understanding the policy and business implications of sustainable innovation; and working with companies to develop sustainable solutions
- Product Sustainability (Understanding the organisational, management, development and design implications of product sustainability)

Contact: Martin Charter
mcharter@uca.ac.uk
www.cfsd.org.uk

BLUE CIRCULAR ECONOMY
Northern Periphery and Arctic Programme 2014–2020
EUROPEAN UNION
Investing in your future
European Regional Development Fund

Western Associates, UK

Western Associates is a long-established research and communications (writing, media relations and PR) agency with specialisms in greentech/"green" alternatives, the creative industries, software and leading-edge data communications. Western Associates helped bring "Breakthroughs: What Business Can Offer Society" (Gunter Pauli, Epsilon Press) to market and was involved in the development, with Martin Woodhouse and Martin Charter, of what was believed to be the world's first downloadable e-books, "Towards Sustainability Publishing" and "The Green Management Guru" by Martin Charter. The agency was founded by Paul Whitehead - professional writer, business journalist and media relations consultant in London, Sydney and Melbourne.



Professor Martin Charter, Director, The Centre for Sustainable Design®, Business School for the Creative Industries, University for the Creative Arts, and Paul Whitehead, Founder, Western Associates

March 2022

For more information email: mcharter@uca.ac.uk

@BlueCircular bluecirculareconomy.eu bluecirculareconomy bluecirculareconomy bluecircular

BLUE CIRCULAR ECONOMY

Northern Periphery and Arctic Programme 2014–2020

EUROPEAN UNION
Investing in your future
European Regional Development Fund