

Circular Ocean

Findings of feasibility studies 2017

The Centre for Sustainable Design ®

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SUMMARY OF THE FINDINGS OF PORT-RELATED FEASIBILITY STUDIES RELATED TO THE COLLECTION AND RECYCLING OF WASTE FISHING NETS AND ROPES IN GREENLAND, IRELAND, NORWAY AND SCOTLAND

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In pursuit of innovative and sustainable solutions for marine plastic waste, the Circular Ocean project seeks to inspire enterprises and entrepreneurs to realise the hidden opportunities of discarded fishing nets and ropes in the Northern Periphery & Arctic (NPA) region.

As increasing levels of marine litter is particularly pertinent to the NPA region, the Circular Ocean project will act as a catalyst to motivate and empower remote communities to develop sustainable and green business opportunities that will enhance income generation and retention within local regions.

Through transnational collaboration and eco-innovation, Circular Ocean will develop share and test new sustainable solutions to incentivise the collection and reprocessing of discarded fishing nets and assist the movement towards a more circular economy.

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Introduction

This report is based on a series of unpublished national port-related feasibility studies focused on the collection and recycling of waste fishing nets and ropes (FNRs). The research was completed by Circular Ocean project partners in Greenland, Ireland, Norway and Scotland during 2016-17. This report includes an executive summary and then a review by each country of the key cross-cutting issues related to waste FNRs, port-related innovation systems and new opportunities.

Executive Summary

- There is a very fragmented picture of the issues surrounding waste fishing nets and ropes (FNRs) in Greenland, Ireland, Norway and Scotland with little research completed to date
- Within each of the four countries there are different levels of fishing activity undertaken, with the number of ports, harbours and landing areas varying significantly. Norway appears to have the biggest fishing industry of the four countries
- Across the four countries there are a mix of in-country manufacturing and assembly of imported FNRs
- Aquaculture is practiced in Norway, Scotland and Ireland but not in Greenland
- There are no specific European or national laws in the four countries that require the take-back and recycling of FNRs
- However, it appears that smaller vessels are exempt from many international and/or European regulations. According to MARPOL¹, vessels smaller than 100 gross tonnes and carrying fewer than 15 persons are exempt from a number of regulations. This exemption suggests that 99% of fishing boats are exempt from MARPOL's stringent waste handling regulations.
- There is a lack of data on the collection and recycling of FNRs in each of the four countries
- Norway seems to be leading on information management and reporting in relation to waste FNRs and the government is presently considering 'producer responsibility' regulation for waste FNRs
- To track the dumping of FNRs a marking scheme appears to have been initiated in Greenland
- In all four countries there are indications that FNRs may be lost at sea, landfilled, incinerated or are often left in piles in harbours and ports.
- Research has indicated short, medium and long-term stockpiling and storage of FNRs in all four countries, this seems to particularly relate to polyethylene (PE) and polypropylene (PP) rather than nylon FNRs, where there appears to be a market
- It appears across the four countries that a significant quantity of waste FNRs are discarded in containers at harbour sides and the main waste management route for non-nylon FNRs is landfill

¹ MARPOL 73/78 is the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978. ("MARPOL" is short for marine pollution and 73/78 short for the years 1973 and 1978.) MARPOL 73/78 is one of the most important international marine environmental conventions.

- There is no universal picture over the waste management of FNRs by country, by region and/or by port
- Waste management of FNRs seems to differ from port to port across and within the four countries
- The structure of waste management fees associated with waste FNRs differs significantly by port within Greenland, Ireland, Norway and Scotland
- There appears to be evidence of repair and maintenance of FNRs being undertaken in ports in all countries
- There are examples of FNR manufacturers in Ireland and Norway that liaise directly with fishermen on take-back and repair of nylon fishing nets
- In Greenland, there appears to be no collection and recycling of FNRs – even nylon – due to a lack of infrastructure – in other countries, collection and/or recycling of FNRs does exist to varying degrees
- A number of pilot projects that have been undertaken by BIM in Ireland and Fishing for Litter in Norway and Scotland to investigate the logistical and economic issues associated with collection and recycling of waste FNRs but it is unclear how successful these have been. Recycling pilots instigated by BIM in Ireland indicated that Nylon 6 can be recycled more effectively than PE and PP. This is partially as a result of the market price of Nylon 6 being significantly higher than for PE and PP. The BIM pilots are described in the reports “Recycling of Waste Fishing nets - Report of Pilot Project 2006-2009” and “Irish Marine Pilot Scheme Finds Use of Recycled Fishing Nets”
- Research has indicated that there are no major mechanical or chemical recycling plants for waste FNRs in the four countries. A feasibility study was undertaken in Scotland on a mechanical recycling plant but the results were not promising, so the project did not move forward. The only key mechanical recycler of waste FNRs in Europe is Plastix Global in Denmark and the only significant chemical recycler is Aquafil in Italy though a plant in Lithuania
- There are beach clean-ups of FNRs and other marine plastics organised by central government and local authorities in Greenland, Norway and Ireland e.g. Clean Coasts currently funded by the Department of the Housing, Planning, Community & Local Government and the Tourism board in Ireland. Research has also indicated that there are also citizen driven initiatives in these countries e.g. there are 540 voluntary groups engaged nationwide In Ireland
- Nofir, based in Norway has developed collection systems for waste FNRs as part of its reverse logistics business which they have extended and expanded to other parts of Europe. It appears that Nofir primarily collect nylon and there are indications that a key client is Aquafil who produce its Econyl fibre using an innovative de- and re-polymerisation process
- There appears to be a lack of clear innovation eco-systems within port areas to enable the development of eco-innovative products from waste FNRs – this needs further investigation
- However, some ports do have companies that might be useful for the development of eco-innovative products using recycled polymers from waste FNRs e.g. plastics producers, plastics recyclers and injection moulding companies

- In some ports, there are companies that produce plastics products for port-based marine industries, where there may be potential to explore the substitution of virgin plastics to recycled polymers derived from waste FNRs
- In the ports surveyed across the four countries, there are only a few eco-innovative companies producing products from waste FNRs, some FNR repair businesses and some limited re-use of FNRs in other product/market applications e.g. football nets

Review of issues related to the collection and recycling of waste fishing nets and reports in ports in Greenland, Ireland, Norway and Scotland

Greenland

Cross-cutting points

- In Greenland there are an estimated 180-200 ports or quays
<http://naalakkersuisut.gl/da/Naalakkersuisut/Departementer/Kommuner-Bygder-Yderdistrikter-Infrastruktur-Boliger/Infrastruktur/Havne-og-lufthavne>
- There are no aquaculture farms in Greenland (and therefore copper impregnated fishing nets and ropes (FNRs) are not used in Greenland)
- The Greenlandic government (Selvstyret) has passed waste management legislation (Legislation no. 12, 17th November 2011, technical conservation measures in the fishery sector) that requires FNRs to be marked with the owner's name and addresses which allows the identification of the owners of the FNRs if they lost. The aim is to track the dumping of FNRs. There are requirements to collect FNRs in Greenlandic waters but in practice FNRs are not collected when lost, since the government doesn't have the resources to enforce the law. But there are indications from a representative of Selvstyret that the volume of waste FNRs being dumped in Greenlandic waters has declined since the legislation was passed
- The municipality of Sisimiut stated that the volume of waste FNRs in Greenland waters is underestimated. However, it is claimed the 95% of waste FNRs are returned to land e.g. not dumped at sea
- Fishermen are required to pay deposit fees on waste FNRs when nets are landed, which appears to be one of the reasons why FNRs are being dumped at sea
- FNRs are imported from various overseas manufacturers including Euronete, Hampidjan or Lankhorst and are assembled by specialist companies in Greenland e.g. Qalut Vonin. This includes trawl FNRs that consist of many different materials and densities of PE, PP, nylon and polyester
- A number of FNR assemblers in Greenland offer repair and maintenance services.
- Beach cleans are organised by local government and it appears that waste FNRs are collected. However, further details are unknown
- There is storage and stockpiling of waste FNRs at harbours whilst it is decided whether the FNRs are to be repaired or sent to landfill. It appears that some FNRs go to back to FNR assemblers for repair. For example, the FNR assembler Qalut Vonin appears to provide temporary storage at Sisimiut port.
- It appears that all types of polymer waste FNRs (nylon, PE and PP) go to landfill due to a lack of reuse and recycling infrastructure in Greenland.

- The cost of transportation of waste FNRs from Greenland to Plastix Global in Denmark for mechanical recycling appears to be prohibitive
- Metals are stripped from FNRs for recycling in Nuuk and Sisimiut and then sent to a small metals recycling plant BJ Entreprises metalgenvinding <http://bje.gl/> who then ship materials to Denmark. Recycling is then organised in Denmark by Reno Nord

Port-related innovation systems, companies and products

- Due to Greenland's early stage of economic development there doesn't seem to be many innovative companies in port areas to enable the development of products from waste FNRs

New opportunities

- With the future development of harbours in Nuuk and Sisimiut, there may be opportunities to build in repair (re-use), separation and recycling infrastructure for polymers and metals from FNRs; and also encouraging entrepreneurs to develop products from waste FNRs sitting in landfill

Ireland

Cross-cutting points

- There are 6 major Fishery Harbour Centres, run by the Department of Agriculture, Food & the Marine, with an additional 40 secondary ports and a further 80 piers and landing places where fish landings are recorded
- The most recent report (2015) by the Licensing Authority for Sea Fishing Boats puts the number of Irish fishing vessels at 2,112 across all sectors. Most of the larger vessels (in excess of 15 metres length) operate from the 6 major Fishery Harbour Centres. However, some of the non-fishery harbour ports account for increasing larger volumes of fish landings. There appears to be a trend towards larger fishing vessels, resulting in fewer small scale fishing boats
- Ports managed by the Department of Agriculture, Food and the Marine meet to discuss a variety of issues. However, there is no formal network amongst other ports to share information and knowledge on port-related issues including waste management and recycling of waste FNRs
- Irish fishermen suggest that fishing nets need to be replaced periodically due to changes to the size of fishing net diamonds required by European Commission (EC) laws. This can create significant costs and problems for fishermen and FNR suppliers as it can drive product obsolescence
- There is a fragmented picture on the waste management and recycling of waste FNRs and a lack of definitive data and information on waste FNRs in Ireland
- Ports and harbours are regulated by pier and harbour by-laws and local authority waste regulations
- There appear to be different regulations related to the waste management of FNRs in different ports and harbours in Ireland
- Waste management appears to differ from port to port and collections of waste FNRs seem to be ad hoc. For example, some ports pay for skips for waste management
- It appears that FNR waste management fees are generally incorporated in port landing fees. However, this does not appear to be uniform across ports
- All ports in Ireland are required to have a waste management plan
- In County Cork ports, it was suggested that 97% of the FNRs used are PE or PP, with the remaining 3% being nylon. This appears to relate to the demersal fishing activity in the area
- Nylon FNRs seem to be mostly used for pelagic fishing in Killibegs (Ireland's largest fishing port)
- The Fishing for Litter (FFL) programme has been implemented in eight Irish ports to date, encouraging fishermen to take ashore the litter they encounter at sea while fishing

- A number of ports nationally have partnered with BIM in an early stage trial to recycle PE and PP FNRs. At the time of completing the research, the status of this trial is unknown
- PE and PP FNRs are stockpiled in skips and directly in piles at a number of Irish piers and harbours
- There is some evidence of long-term stockpiling and storage of PE and PP FNRs e.g. up to 5 years in some ports or harbours. For example, one port reported a stockpile of 8-10 tonnes at the time of the research visit. At time writing this report, BIM have begun collection of PE nets for a trial, which may temporarily alleviate the stockpiles of nets in many ports
- The stockpiled PE and PP FNRs are normally contaminated and include mixed materials e.g. metals, rubbers, etc.
- There also appears to be some private storage of FNRs by fisherman
- There is a culture of repairing PE, PP and nylon FNRs in ports due to cost of buying new FNRs
- One fishing net manufacturer liaises directly with fishermen on take-back and repair of nylon fishing nets
- Some fishing net manufacturers appear to be exporting waste FNRs for recycling in Europe
- Dyneema rope is being increasingly used by fishermen. Dyneema is made from UHMWPE (Ultra High Molecular Weight Polyethelene) and is difficult to recycle, yet lighter than older combination ropes that included PE and steel which is heavy and also difficult to recycle

Port-related innovation systems, companies and products

- There are expansion and development plans for Killibegs and Castletownbere ports
- There are different densities of local innovation actors in and around Irish ports
- Many ports have injection moulding companies located in or near their towns
- There are clusters of marine and fishing related businesses in a number of port areas

New opportunities

- A social enterprise model for the segregation of FNR materials has been suggested as a possible outlet. There are established social enterprises in existence in Ireland that deal with “problem” waste streams that might be interested in waste FNRs, if there was a business case
- Anecdotally, it was suggested that donations of ‘end of life’ nets were being used to make
 - Football nets
 - Turf sacks
 - Silages bales
- Informal discussions indicated that FNRs are also being used in other countries to reinforce large areas of concrete such as airport runways

Norway

Cross-cutting points

- There are about 600 state fishing ports in total in Norway (Source: <https://www.worldportsource.com/ports/index/NOR.php> & <https://www.barentswatch.no/en/ports>)
- Fishing ports in Norway are organised as municipal or inter-municipal enterprises that act as landlords with some quays being privately owned. Private companies such as fishermen, fish processors and fishing net suppliers may rent space and facilities from the ports (Source: https://en.wikipedia.org/wiki/Kommunalt_foretak & https://en.wikipedia.org/wiki/Interkommunalt_selskap)

- The EU Directive on port reception facilities for ship generated waste and cargo residues established in 2000 was implemented by Norway in 2003. An inspection by the European Maritime Safety Agency (EMSA) uncovered that the Norwegian regulations had not implemented the EU Directive in an adequate manner and that many ports in Norway did not have Port Waste Management Plans (PWMP). Norwegian regulations were tightened in 2013 and all ports should have provided updated PWMP's to the County Governor by July 1st 2014. There are indications that waste regulations of smaller ports and docks are still problematic (Source: <https://www.fylkesmannen.no/Documents/Dokument%20FMNO/Milj%C3%B8%20og%20klima%20dokumenter/Barents%20og%20Nordkalott/Presentation%20Finnmark.pdf>)
- It appears that the waste fee system for waste FNRs are not harmonised across ports. In some ports the fees are part of the port landing fee and in other ports there are specific fees
- Some ports do not have dedicated reception facilities for waste FNRs (but may have for general waste, where FNRs may be deposited with other forms of waste).
- Research indicated that a number of ports believed that they did not receive any FNRs and the reason for this was unclear
- Some FNR suppliers, such as Selstad, take back obsolete gear from fishermen against a fee to cover waste handling costs. The gear is further transported for recycling by Nofir
- Nofir collects FNRs from both fisheries and aquaculture
- Some ports as well as FNR suppliers offer storage facilities for gear that fishermen may rent. The need for FNR storage may be due to seasonal factors (type of fish and type of FNR), back-up, quotas or gear obsolescence
- A two year trial by 'Fishing for Litter' (FFL) scheme was set-up in January 2016 with reception facilities in Tromsø, Ålesund and Egersund, stretching along the entire Atlantic coast (Source: <http://www.miljodirektoratet.no/no/Publikasjoner/2017/April-2017/Fishing-For-Litter-som-tiltak-mot-marin-forsopling-i-Norge/> & <http://www.miljodirektoratet.no/no/Nyheter/Nyheter/2017/April-2017/God-oppslutning-om-Fishing-for-litter/> & <http://www.miljodirektoratet.no/en/News1/2015/Time-to-Fish-for-Litter/>)
- The Norwegian Environment Agency (NEA) have awarded a contract to Nofir for the collection and recycling of the waste fraction that consists of fishery-related marine debris from the FFL programme (Source: <http://www.miljodirektoratet.no/no/Publikasjoner/2017/April-2017/Fishing-For-Litter-som-tiltak-mot-marin-forsopling-i-Norge/> & <http://www.miljodirektoratet.no/en/News1/2015/Time-to-Fish-for-Litter/>).
- Anyone that loses or cuts FNRs adrift has a duty to search for the FNR. The Norwegian Ministry of Trade, Industry and Fisheries may grant exemptions from the duty to search for gear (Source: <http://www.fiskeridir.no/English/Fisheries/Regulations/The-marine-resources-act>)
- FNRs that are lost and not retrieved must be reported to the coast guard central (Source: <https://www.barentswatch.no/en/articles/Marin-forsopling/>).
- For vessels >15 metres lost FNR may also be reported to Norway's Directorate of Fisheries (Fiskeridirektoratet) through their Electronic Reporting System (ERS)
- The fishing activity is monitored by the coast guards. However, this simply relates to the number of vessels that are fishing in their territory and what type of FNR they are carrying but they don't account for any lost FNR. The data from the coast guard is available on the website: <https://www.barentswatch.no/fiskeriaktivitet/> .
- The Directorate of Fisheries organise annual FNR clean-ups in the ocean based on recorded FNR loss. Reports from these clean-ups are published via their website
- A government white paper on waste management is expected to be published in 2017 and is predicted to highlight possible measures to mitigate abandoned and lost FNRs.

Port-related innovation systems, companies and products

- There are different densities of local innovation actors in and around Norwegian ports
- There are clusters of marine and fishing related businesses in a number of Norwegian ports
- In Ålesund there appears to be components of a local innovation but it is unclear if there are any plans to develop eco-innovation within the future port masterplan

New opportunities

- The injection moulding company Plasto is currently piloting the use of PP and PE from waste FNRs to create walkways for fish farms using an injection moulding process. The testing is aimed at checking the strength and durability of the product when using waste FNRs instead of virgin raw material

Scotland

Cross-cutting points

- There are an estimated 100 ports in Scotland www.portsofscotland.co.uk/
- There is a range of legislation that potentially covers waste management at a port level but there appears to be no specific legislation that covers waste FNRs
- Port waste management planning is mandatory (Merchant Shipping (Port Waste Reception Facilities) Regulations 2003 (Statutory Instrument 2003/1809) and is detailed in Marine Guidance Note (MGN) 253 and "A Guide to Good Practice"). However there are indications from published Scottish Port Waste Management Plans (PWMP) that weight or volume data are variable or unreported, with none of those PWMP quantifying waste FNR data specifically.
- Recent research indicated the difficulty of obtaining data on both end-of-life FNRs and sales of FNRs in Scotland. Industry information is not generally available.
- In September 2015, KIMO UK estimated that around 200 FNRs were manufactured in the Peterhead area per annum.
- Initial suggestions estimated the mass of waste FNRs was 1000 tonnes per annum but subsequent research indicated this figure was too high and that amount was thought to be closer to 700 tonnes per annum.
- Harbour masters are responsible for waste management at Scottish ports
- FNR waste management practice is not consistent across Scottish ports. In some instances fishermen pay for containers directly or pay a fee to harbour masters to manage waste FNRs. In this instance, fishermen pay a management fee - of approximately 15% of the catch fee - that covers waste management and other costs
- In Scotland FNRs are lost at sea, landfilled, burnt or incinerated or are often left in piles in harbours and ports
- A significant quantity of waste FNRs are discarded in containers at harbour sides and the main waste management route is landfill. The FNRs deposited in the containers are often highly contaminated with organic matter and 'anti-foulant' coatings (including copper) from aquaculture. For example, at the time of the research, 20 tonnes of FNRs are presently sitting in piles at the port of Scrabster.
- Determining the ownership of waste FNRs is also problematic.
- Disposal to landfill of FNR costs in excess £125 per tonne including landfill tax, site charges and transport. The cost is considerably more in remote areas
- In 2015-16, KIMO UK started trials in Peterhead, Scrabster and Ullapool with Plastix Global <http://plastixglobal.com/> to collect and recycle a variety of PE (Polyethylene), PP (Polypropylene) and PA (Nylon) waste FNRs. Fishing for Litter (FFL) Scotland (KIMO UK) accept EOL FNRs fished from the sea by fisherman into their waste stream at no cost. The scheme aimed to collect all EOL FNRs, not

just those lost at sea which were already being collected by FFL. 50 tonnes were collected with most sent to Plastix Global in Denmark and one load going to Nofir in Lithuania. The scheme has now ended due to challenges with collection

- Zero Waste Scotland (ZWS) research indicated that there were limited markets for recycled PE polymer from FNRs in the end product manufacturing industries in Scotland, since there is a perception that the mixed polymer was of a lower grade and may contain a mixed fraction of other polymer types. With the decline in global polymer market prices, this resulted in both PE and PP fractions being less economic to process in many economies and therefore less attractive to economies where operational costs are higher. There are no Scottish or UK based facilities capable of processing post-consumer nylon, with the nearest operations based in continental Europe
- Research into the feasibility of establishing a plastic processing plant in Scotland using waste FNRs concluded that it was not economically feasible to set up a facility and research ended in March 2014. Predictable volumes and, contamination and separation of FNRs as well as prohibitive labour costs were all cited as key problems

Port-related innovation systems, companies and products

- Little information was collected on innovation actors operating in Scottish ports
- A makerspace - MAKLAB - in Wick is sited 20 miles away from Scrabster
- Since 2001, £35 million has been spent to develop the port of Scrabster <http://www.scrabster.co.uk/port-development/#Background> - and there are further development plans <http://www.scrabster.co.uk/port-development/#>

New opportunities

- ZWS were involved in some initial research on the development of new fishing net disassembly technology

More Information on the national studies

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