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AM500218 - Creating value from waste

Upcycling potential of marine litter

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Abstract

This report explores upcycling possibilities for marine litter within the aquaculture and fisheries industries in Møre and Romsdal county in Norway. Many of the different aspects of upcyling will be introduced, as well as potential challenges.

To be able to understand the industries in this region, a survey was made and sent out to some of the main industries in Møre and Romsdal. This survey covered their current situation, and asked questions about their attitude and thoughts regarding the use of upcycling products. From this survey it was noticeable that many of the industries are using recycled materials from certified sustainable sources, as well as recycling their waste. However, there was not many industries with an upcycling programme in place, even though there were a lot of positive attitudes towards upcycling as a waste management method.

Upcycling marine litter requires initial financial commitment, but a circular economy approach offer long-term value for these products. Implementing an upcycling waste management solution contributes with unlocking new markets, potential cost reduction, mitigating regulatory risks and could improve investor appeal, resulting in a potential financial benefit as well as an environmental benefit.

However, the research done in this report highlights significant challenges and limitations for upcycling plastic marine waste for industrial use. This is mainly due to the inconsistent quality and composition of the waste, as well as degradation of the original product. Upcycling shows promise for non-industrial use where the material requirement is lower, such as flowerpots and art, as there are endless products to be made.

In general, there is a big potential for improvement in the tackling of marine litter, where both upcycling and recycling are essential methods. Further research is needed to fully understand the limits and the potential for upcycling for all industries. The attitude towards an environmental future is present and might just need some more guidance to discover the path ahead.

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1. Introduction

There is no secret that the world today is driven by overconsumption and overproduction. In 2024 all the natural resources that the earth can produce in twelve months were used by the 1st of August (WWF, n.d.). To put it in another perspective, today the ecological recourse demand of individuals, governments and businesses around the world is the equivalence as if we lived on 1.7 earths (GlobalFootprintNetwork, 2019). This is not sustainable in the long run. Sustainable development was defined in Our common future by the United Nations Brundtland commission in 1979 as meeting "the needs of the present without compromising the ability of future generations to meet their own needs." (p. 16). Regarding overconsumption, Norway has the second highest consumption per capita in Europe (Rauan, 2024). This indicates that there is need for a change in the production and consumption.

A possible solution for overproduction is by recycling or upcycling materials that have already been produced. As part of the European Union's Horizon 2020 Research and Innovation Program, the RECLAIM Project has received funding to investigate potential actions and solutions for waste management in marine environments. As the main goal for the RECLAIM project, a low-cost AI-powered robotic material recovery plant has been developed, which will initially be deployed in the Greek Islands. The equipment will soon be operating at full capacity (EuropeanCommission, 2021, a).

Maritime litter, also known as marine debris, is a growing environmental issue that affects oceans, seas, and waterways worldwide. It consists of human-made waste, such as plastics, fishing gear, and industrial materials that enters the marine environment through improper disposal, runoff or direct dumping. This pollution poses severe threats to marine ecosystems, wildlife, and human livelihoods by harming marine animals, disrupting ecosystems, and contributing to economic losses in industries like fishing and tourism.

As part of the RECLAIM project, the Møre and Romsdal county in Norway is collaborating with NTNU to support the industry to reduce waste production through the introduction of upcycling and recycling practices. As a part of the collaboration an interdisciplinary team of students was put together to work on the project. The team for this project was a cooperation of students at NTNU. The fields of studies that were represented in the team was mechanical engineering, international business, Information security and ocean resources.

Each member had their strengths regarding the project work. The team were given a work package (Appendix 1) which they could work from. This led to the team formulating the project goal as “What are the main issues with marine litter, how much is there?” and “How do local marine industries in Møre and Romsdal view the potential of using upcycling as an alternative for waste management?”

This report will give an overview on upcycling as a potential waste management method for industries in Møre and Romsdal. Chapter 2, Theory, will investigate the theoretical background supporting the context of these report, before chapter 3 introduces the RECLAIM project. The last 4 chapters introduce the method of research, as well as providing results, discussion and a conclusion to our project research.

2. Theory

2.1 Plastics

Plastic is a material which has revolutionized the daily lives of humans over the last 70 years, with production reaching in excess of 450 million tonnes per year worldwide (Ritchie et al., 2023). Figure 1 shows how the global plastics production has developed since the 1950’s.

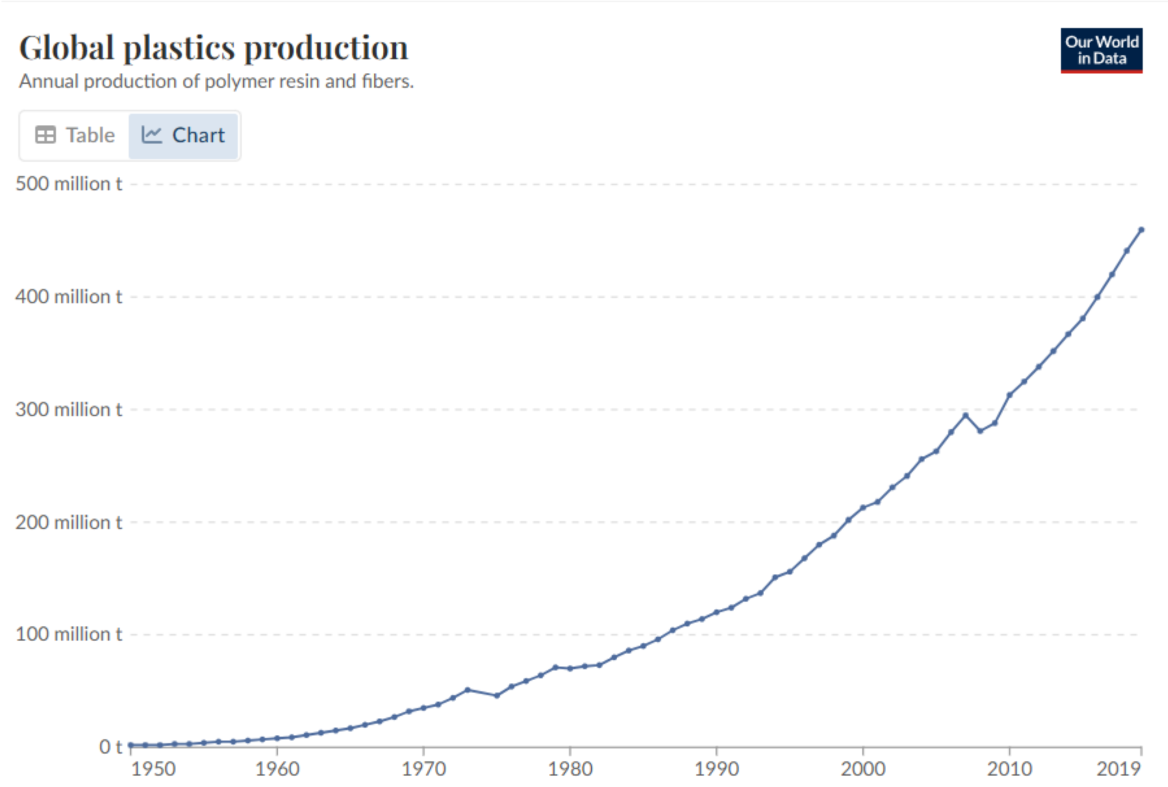

Figure 1: Global plastics production (Ritchie et al., 2023)

Plastic is a term used for a wide range of materials with similar material properties and are categorized as synthetic polymers (Thompson et al., 2009). There are over 20 different groups of plastic polymers, with different grades and varieties. Common for most of them are that they are prepared by polymerization of monomers derived from oil and gas (Thompson et al., 2009).

Plastics are a preferred option in many situations, mainly because of the material properties of the different plastic polymers. Table 1 lists some of the most important material properties and some advantages of plastic polymers (Atienza & Climent, n.d).

Table 1: Lists valued material properties and benefits of plastic polymers

Material Properties	Advantage of plastic polymers
Strength	The strength of the different polymers varies. Polymers like Nylon have a high tensile strength
Density	Most polymers have a density between 0,85 – 2 g/cm3. This enables use of polymers for weight sensitive applications.
Shape-ability	Complex shape structures can be created, for example from 3D-printing and plastic extrusion.
Corrosion resistance	Plastic polymers do not experience corrosion. Great advantage in highly corrosive environment.
Electrical and Thermal conductivity	Most polymers are poor conductors of heat and electricity. This makes them a good option to conceal heat and electricity.
Elasticity	Polymers as rubber are very elastic, making them ideal for application with high level of vibrations.

In addition to good material properties, the cost of plastic polymers is relatively low compared to other structural materials, and makes plastics an ideal material for many applications, and is the reason for the high production rate of plastics.

Despite the many advantages, the use of plastics is a point of discussion. Production of plastics are accountable for approximately 8 percent of global oil usage, resulting in huge environmental consequences (Thompson et al., 2009).

In addition, there are around 16 000 different chemicals used in the production where more than 4 200 are of concern (Wagner et al., 2024). This is because these chemicals often are persistent, bioaccumulate, mobile and/or toxic. In other words, the chemicals can have a long-time presence in the environment, such as soil, air and water, as well as being able to stay and accumulate in living organisms. Including this they can be transported through fresh- and drinking water systems and may be toxic for living organisms and cause them harm (Wagner et al., 2024).

As a result of this, the plastic production quantity needs to be assessed. Due to the environmental consequences, as well as unknown toxicity for living organisms, the amount of plastic production and plastic waste in the nature must decrease. Solutions for reuse of plastic polymers is vital to support this change.

2.2 Marine Litter

Marine litter, particularly plastic waste, has become one of the top environmental problems of our time. An estimate of 15 million tons of plastic enters the ocean annually (Haarr et al., 2022).

Marine debris originates from both land-based and ocean-based sources. Ocean-based waste originates mainly from commercial fishing and offshore industries such as lost fishing gears and other items from vessels and platforms at sea (NOAA, 2025, c). Waste like fishing gears such as nets, trawls, plastic ropes, buoys, plastic utilities like pots/buckets and containers are of high contribution to the marine litter pollution (Deshpande et al., 2020). The picture below (Figure 2) provides an overview of the sources of plastic pollution in the ocean.

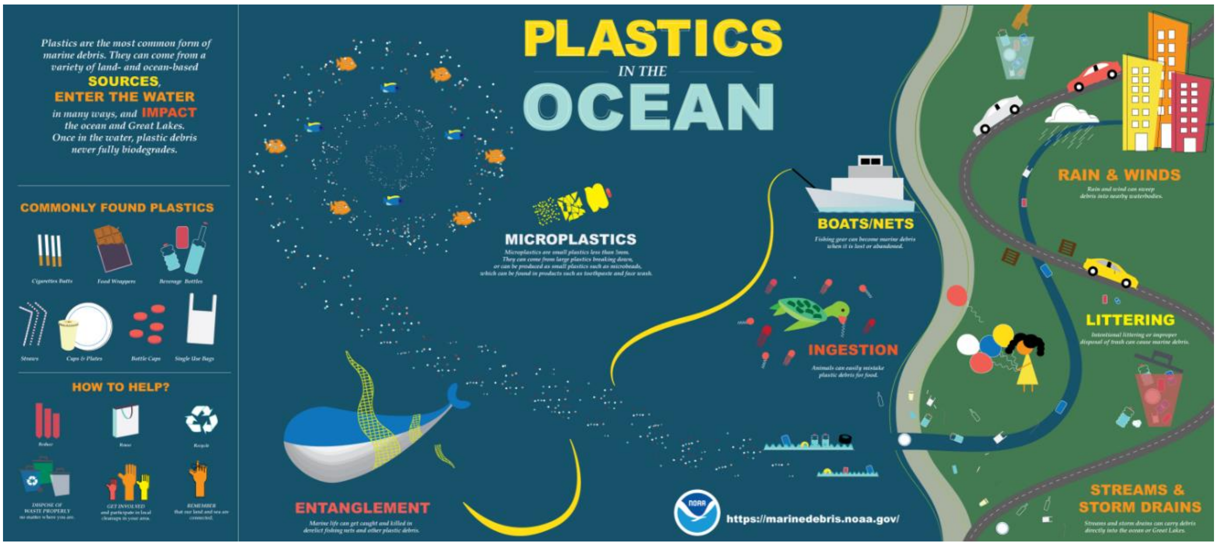

Figure 2: Image retrieved from the NOAA Marine Debris Program and illustrated sources of plastic pollution in the oceans..(NOAA, 2025, a).

When plastic waste enters the open sea it accumulates on shorelines, coastal areas, the sea floor and also to other far away distances around the world. Due to areas with high population density, commercial shipping lines, and through ocean currents the distribution of ocean surface litter that floats create an immense problem (Galgani et al., 2015). As we see with the great pacific garbage patch, which have a total mass of 100.000 tonnes of plastic floating freely in the Pacific Ocean outside the coastline of California. For illustration, this garbage patch is roughly twice as big as the size of Texas (TheOceanCleanup, n.d.).

Depending on the plastic type it can take from 10 to over 600 years to degrade (TheOceanConservancy, 2003). Using the word *degrade* can be somewhat misinformative, because during this time the plastics breaks down to smaller fragments, sometimes too small for the human eye to see. The plastics degrades due to sun/UV light, saltwater, movement from waves, temperature, moisture, microorganisms and general environmental conditions (NOAA, 2025, b; Singh & Sharma, 2008). When the plastic degrades, it degrades to such a level that it can be below the size of 5 mm, commonly called microplastic (Cyvin et al., 2021). This reduces initial mass, but it does not change the actual plastic present in the ocean (Chamas et al., 2020). Some environmental implications of what marine litter can lead to are entanglement, suffocation, starvation and death to marine mammals. When plastics degrade to microplastics it might be absorbed by plankton, which then can be eaten by other marine species (Bajt, 2021). This will lead to an accumulation of plastic particles and chemicals throughout the food chain and end up in our own food (Reddy, 2018). Microplastics consists of the same chemicals as regular plastics, but are more porous due to degradation, so other particles such as persistent organic pollutants (POPs) can bind to the fragment. These chemicals can inhibit natural biochemical reactions, for example by having hormone disruptive properties (Bajt, 2021). We can see how the problem of marine litter is a major cause of environmental and ecological hazards.

Marine litter is not limited to plastic waste, as we have primarily focused on so far. It is important to include waste such as metal, rubber, cigarette butts, plastic bags, paper, textiles, shipwrecks, abandoned vessels and construction debris when talking about marine litter (NOAA, 2025, a). Oil spills, wastewater/sewage and chemical runoffs is also a major concern for the marine environment (Abirami, 2024). Ultimately, human activities and lifestyles are the primary drivers of environmental and ecological changes in, and around, the ocean.

2.3 Waste on Norway's West coast

When plastic waste and debris form on the Norwegian coastline it piles up among seaweed, stones, grass, in peat, soil, wetlands and ponds. The plastic collects in different areas depending on the type and consistency of the plastic fragments, which might also have been accumulated over the course of decades. Some of these also originate from different parts of the world. Plastic waste is also part of changing the landscape. For example, the waste is damming up natural ponds along the coast which make them increase in size. By accumulating along the coast, the volume of soil and peat also increase. This change in the environment is part of an unnatural evolution which potentially is a leading factor of changes to costal ecosystems around the globe, not only in Norway (Bastesen et al., 2021).

When looking at an "isolated example", an area explored along the coast of Trøndelag in Norway, we see that the problem of plastic waste could have huge implications both on the local ecosystem and marine environment.

Mausundvær and Froan are two uninhabited islands outside Frøya, where there have been done some testing regarding marine litter. The tests shows that the marine litter does not only include accumulated plastics that are visible and touchable, but also smaller debris that are not visible to the naked eye. Microplastics as well as macroplastics (above 5 mm) mixes with the soil and seaweed around the islands. Over time these particles get buried in the soil and even when costal renovators clean the shores from waste, the plastic debris accumulated deep in the soil are not able to be cleaned by the renovators (Cyvin et al., 2021).

Soil tests were taken as far as 100 meters from the shoreline to compare with soil samples closer to the ocean. When comparing, the recorded results showed a concentration of plastics from 3% up to 72% in the soil samples taken close to the ocean. This can lead to several ecological impacts. If bushfires flare up on the islands, the chemical substance originating from the plastics could bring even more pollution to the soil (Cyvin et al., 2021). Burning plastics also spread through the air. When the plastics melt some of the chemicals might evaporate and spread through the air to different regions (Pathak et al., 2023). Plastiglomerates, the mix of melted plastic and organic debris such as stones and shells, can also be created during fires, fundamentally transforming the soil properties (Cyvin et al., 2021; OceansToEarth, n.d.). This also adds to the harmful implication's plastics have on the environment.

This research was conducted in Norway, a country where waste management is closely monitored and regulated by the Norwegian government as well as regulations from the European Union (FHI, 2021). The rules and regulations around waste management are made to be strictly followed by Norwegian municipalities and the local industry (FHI, 2021). The findings around the islands outside Frøya highlight the importance of this topic, and improved waste handling strategies such as upcycling from marine industries could be a crucial contribution to make changes to marine litter accumulating along the Norwegian coast.

2.4 Recycling & Upcycling

Since there are a lot of waste produced, that enter the ecosystem, there needs to be a proper waste management system. There are two types of systems that resemble each other and are reusing old materials for new products. This is recycling and upcycling.

2.4.1 Recycling

One of the most efficient and well-known method to reduce the environmental impact of plastic production and lifecycle is recycling. It represents one of the most dynamic areas in the plastic industry today (Hopewell et al., 2009). Recycling is a process where trash, which would otherwise be thrown away, are collected and processed into new products (EPA, n.d.). Figure 3 illustrates the main steps of the recycling process.

Figure 3: The Recycling Process (APR, n.d.)

Recycling of plastic provides opportunities for the material to be processed and reused, and hereby reducing the demand for new plastic production. This results in an opportunity to reduce oil usage and carbon dioxide emissions, as well as a reduction of the quantities of waste requiring disposal (Hopewell et al., 2009).

Plastic recycling has been a relevant method since the 1970s, however the quantity of recycled plastics has increased as environmental focus and economical possibilities have increased (Hopewell et al., 2009). Advancement in technology contributes to better sorting of the plastic material, resulting in better material properties for the recycled products (Hopewell et al., 2009).

Plastic recycling can be divided into 4 main processes: Collection, sorting, size reduction and cleaning, and further separation (Hopewell et al., 2009).

The first, and the most crucial, step of plastic recycling is to collect the plastic waste. There are multiple different methods that can be implemented to collect plastic waste. Hopewell mentions methods like Curbside Collection, where residents recycle their own waste themselves before it is collected by recycling services. Bring Schemes is another method where there are drop-off points where people bring their sorted waste for recycling, as the main collection method (Hopewell et al., 2009). Collecting plastic waste from the ocean is more challenging and will demand extra effort and cost into the collecting process, as individuals can't contribute on the same scale.

The next stages of the recycling process are related to sorting and separating the waste. This is a crucial and necessary process as the plastic polymer waste have different material properties and could also contain non-plastic materials. Advancement in technology have improved these methods, resulting in better products. Automated methods like Fourier-transform near infrared spectroscopy, optical colour recognition camera systems and X-ray detection are some of the techniques used by recycling facilities (Hopewell et al., 2009).

After sorting and separating the waste, size reduction, cleaning and further separation of the waste is necessary. The plastic waste is firstly grounded into smaller flakes, before it is cleaned, to remove contaminations like food residues, pulp fibres and adhesives (Hopewell et al., 2009). Lastly a wide range of advanced separation techniques are performed to separate the different plastic polymers from each other. Techniques like sink/float separation, air elutriation, laser-sorting and colour sorting are just some of the techniques that is being applied to the plastic waste (Hopewell et al., 2009). After all these processes are performed, the plastic waste is separated into clean polymers, ready to start a new journey as new product.

While recycling of plastic is an excellent method to add value into plastic waste, this method also has its flaws. Recycling of plastic is an energy and cost demanding process, as the plastic waste have to go through many complex processes, as described above. The final products material properties are in most cases not as beneficial as the material of new plastic. Further technological advancement could improve the quality of the material, however other methods that can reuse plastic waste without completely reprocess the material could in some cases be a better solution.

2.4.2 Upcycling

Recycling of plastic is a downcycling method as the material properties of the end product is not retained throughout the recycling process (Zhao et al., 2022). Upcycling on the other hand uses the waste in a new way without degrading the material and therefore keeps or improves the value of the waste (Zhao et al., 2022).

Some examples of upcycled products can be seen on Figure 4a-4c:

Figure 4: Examples of Upcycling (Mughal, 2024) a. Moulded bricks used as building material. b. Plastic used to create clothes. c. Bottles used as flowerpots.

Figure 4a shows an example where moulded bricks are used as building materials, in this case for rollers for sliding vessels in to or out of the water (Mughal, 2024). Figure 4b shows an example where plastic waste is incorporated by designers to create clothes with both a stylish and sustainable appearance. Figure 4c shows an example where plastic bottles are used to grow plants, replacing the need of new flowerpots (Mughal, 2024).

The examples above are just a short introduction to different applications where upcycled plastic waste could be used. By browsing the internet, one could find countless creative ways of applications for upcycled products made of plastics. Below is a short list of other potential applications where upcycled plastic waste could be used:

- Using plastic bottles and bottlecaps in art by doing small modifications to the bottles and bottlecaps, and using adhesives to shape creative art.
- Reusing car tires as fenders on boats or docks, or anywhere else where a soft surface with spring-like effect is preferred.
- Making both functional and visual aesthetic indoor or outdoor products. Individual persons can create whatever they need or find visually appealing.
- Cut out the handle from a damaged plastic can and use it as a scoop to remove water from your boat after a heavy rainfall or use the scoop to perfectly feed your pet with the right amount of food-pellets per serving.

Upcycling shares many of the benefits of recycling, as this helps reduce plastic waste and reduces the need of production of new plastics (Mughal, 2024). However, there are advantages and disadvantages when comparing upcycling with recycling.

The benefit of upcycling compared to recycling waste are cost efficiency, time efficiency and sustainability. While recycling is a time and cost-consuming process, described in the recycling chapter, upcycling of plastic waste does not require degrading the material (Zhao et al., 2022). New upcycled products can be made from plastic waste with just some minor modifications, such as washing, painting, cutting, shaping and adding adhesives, which are minor compared to the recycling processes. Individual persons can also create unique products with just some minor equipment.

While the process itself has many benefits, the limitations are huge compared to recycling. While recycling of plastic waste can create new materials, with material properties close to the original product, upcycling of material can only be used to create some products based on the waste. Plastic waste has a big variety of shape, form and material properties, making it difficult to standardise products, as each part of waste is different from each other.

2.5 Financial implications

As previously mentioned, the offshore and fishing industries are among the main contributors to marine litter. Not only is littering harmful to the environment, but it also creates economic losses for the industries. This is due to lost assets, reduced productivity and increased costs for clean-up or compliance (McIlgorm et al., 2022). Significant economic commitments and considerations needs to be taken, both in terms of upfront investments and long-term returns, when it comes to the development of marine litter solutions. This applies especially in shipping- and aquaculture industries as well as fisheries (OECD, 2020).

Although these new systems can be expensive to implement, they are increasingly seen as economically strategic, not just environmentally sound (OECD, 2020). One framework that can highlight the economic potential is the circular economy, as it promotes keeping resources in use for as long as possible and minimizing waste (EuropeanCommission, 2020; Stahel, 2019). Applying this framework to marine litter could not only create opportunities to reduce costs, but also generate value from waste, as well as improve access to sustainable finance (Haupt et al., 2016). When creating value from waste the waste hierarchy is a principal that supports the transition to circular systems and can be found in Figure 5.

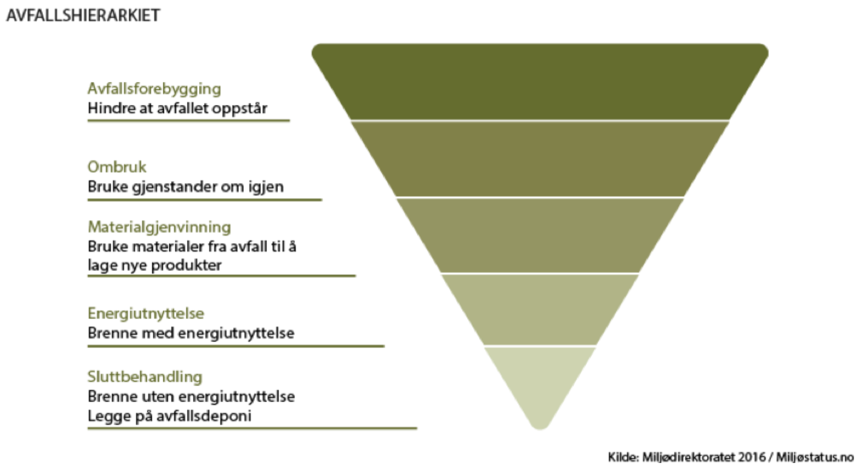

Figure 5: The waste hierarchy (Miljødirektoratet/Miljøstatus.no, 2016).

The framework of the hierarchy ranks ways of handling waste, from what provides the least to the greatest environmental and economic benefit. Prevention is at the top, followed by reuse, material recovery, energy recovery and landfilling as a last resort (LOOP & Lindberg, 2024). By prioritizing prevention and reuse, the hierarchy supports circular economy goals such as resource efficiency, lower operating costs and value recovery, which are key considerations for the fisheries and aquaculture industry.

One of the most important economic considerations is the initial investment, as implementing waste collection systems on board vessels, upgrading port infrastructure or collaborating with recycling and recovery companies requires a lot of capital. However, these investments are increasingly supported by public and private funds. For example, the EU's Blue Economy Strategy and Norway's National Action Plan against Plastic Pollution provide grants and incentives to support sustainable marine initiatives (EuropeanCommission, 2021, b; NorwegianMinistryOfClimateAndEnvironment, 2022). This makes it easier for fisheries and aquaculture companies to participate in circular projects, as they do not have to bear the entire financial burden themselves.

Over time, circular practices can lead to significant cost savings, through reduced operating costs. This is achieved by reusing lost equipment, reducing waste fees, and recovering value from materials such as rope or nets. According to the Ellen MacArthur Foundation (2019), circular business models offer substantial opportunities to reduce resource use and costs by improving material efficiency and extending product lifecycles. In fisheries, selling discarded nets for recycling or converting waste into usable components (e.g. crab pots or insulation material) reduces both replacement costs and environmental liability.

In addition, circular systems create new revenue streams. Marine litter, such as abandoned equipment or plastic containers, can be repurposed into something new. Companies such as the Seaqual Initiative and Oceanworks are already demonstrating how fishing and aquaculture waste can be transformed into marketable goods (Oceanworks, n.d.; SeaqualInitiative, 2024). As demand for sustainable products increases, these markets are expected to expand (Haupt et al., 2016). This creates opportunities for local industries looking to diversify their income sources in regions such as Møre and Romsdal.

Switching to circular solutions also helps manage risks, both regulatory and reputational. With increasing international pressure from frameworks such as the International Maritime Organization (IMO) and OSPAR, companies are facing increasingly stringent expectations to reduce their marine litter emissions (IMO, 2018; OSPAR, n.d.). This approach will therefore help companies comply with the requirements, as well as avoid fines and improve their public image, all of which have financial implications (UNEP, 2023).

Last but not least, circular economy initiatives often involve collaboration and innovation partnerships. Such alliances also reduce financial risk. Fisheries and aquaculture companies can collaborate with NGOs, research institutes or startups to share costs and access innovation funding. According to OECD (2020), partnerships are key to growing circular solutions, especially in traditional industries, because they help people work together and make a bigger impact. In this project, the RECLAIM initiative provides an example of a local platform that encourages this type of collaboration between the public and private sectors to explore the upcycling potential in coastal Norway.

2.6 Technologies

The impact of technology on circular economy has been widely explored by researchers and industry experts, focusing on the role of both existent and emerging technology trends (Bai et al., 2022). As oceans continue to suffer from plastic pollution, abandoned fishing gear, and other waste, innovative solutions are being developed to not only remove waste but also repurpose it into valuable materials. Advancements in artificial intelligence (AI), automation and robotics, biotechnology, and material science are enabling more efficient collection, sorting, and processing of marine debris. Additionally, blockchain and IoT enables devices are improving transparency in waste management and supply chains (Piscicelli, 2023). By integrating these technologies, the upcycling of marine waste can become more scalable and economically viable, contributing to a circular economy while reducing ecological damage.

Table 2 provides an overview of new emerging technologies to support circular economy initiatives (Stahel, 2019).

Table 2: Examples of new emerging technologies to support circular economy initiatives (Stahel, 2019).

Technology Area	**Technology**
Automation and Robotics	- Automated Sorting & Recycling Systems, improve waste separation and increase recycling efficiency. - Robotic Disassembly, recovers valuable components from used products.

Digital Technologies	- Artificial Intelligence (AI), optimizes waste management and enhances predictive maintenance. - Blockchain, ensures traceability of materials and improves transparency in supply chains. - Internet of Things (IoT), enables real-time tracking of products and materials. - Big Data & Analytics, provides insights into material flows, waste reduction and circular business opportunities.
Advanced Recycling	Innovative recycling methods such as Chemical, hydrothermal and enzymatic recycling help recover valuable materials and reduce waste.
Material Innovation	Material innovation exploring sustainable alternatives such as mycelium-based packaging, algae-based plastics, and bio-leather to extend product lifespans and reduce waste.

3. RECLAIM Project

The RECLAIM project has been introduced as part of the European Union's Horizon 2020 Program, EU's main funding program for research and innovation from 2021 to 2027 (EuropeanCommission, 2021, a). The Program main goals are to support organizations to tackle climate change, achieve the UN's Sustainable Development Goals and boost the EU's competitiveness and growth (EuropeanCommission, 2021, a).

The RECLAIM project scope is to improve waste management and collection through the development of a portable robotic material recover facility (MRF) tailored to small-scale material recovery. Recyclable materials recovery is usually performed manually at facilities settled in the vicinity of dense urban areas. Recent AI and robotics developments allow the automation of several MRF activities. However, this solution is not cost-effective. It's also not suitable for large waste volumes and not for smaller areas (EuropeanCommission, 2021, a).

RECLAIM adopts a modular multi-robot/multi-gripper approach for material recovery, based on low-cost Robotic Recycling Workers (RoReWos) (EuropeanCommission, 2022). An AI module combines imaging in the visual and infrared domain to identify, localize and categorize recyclables. The output of this module is used by a multi-RoReWo team that implements efficient and accurate material sorting. Further, a citizen science approach will increase social sensitivity to the Green Deal. This is accomplished through the development of the PlastOpol app, which enables and encourages citizens to participate in waste collection activities by providing annotations to be used in deep learning for the re-training of the AI module (EuropeanCommission, 2022).

4. Method

4.1 Literature research

To understand the extents of how severe the effects of marine litter and the need for upcycling and recycling is, an extensive literature research was conducted. By using google scholar, researchgate and sciencedirect to find English journals and academic texts about the topic, the group ended up with a “research library” of sixteen documents supporting our project work. After reviewing abstracts and titles of the documents the group found most of the papers gathered usable and relevant. Searching the web for websites was also done and some valuable sites such as the National Ocean and Atmospheric Administration (NOAA) was found very useful. The findings from the literature research showed how important new innovative solutions for maintaining environmental sustainability is in the current time we live. The literature research also provided the group with relevant insight and new knowledge to the general topic surrounding sustainability which was important to do the task provided by the RECLAIM project work package. The theory section sums up the information that was recovered through resources online and some which was provided by a contact within the RECLAIM project. The literature research led to the next phase that was to create a survey (Appendix 2) which could be sent out to industries in the Møre and Romsdal county. The survey would help with understanding how industry actors perceived the financial implications as well as giving an insight to current practices, interest levels and potential barriers to upcycling.

4.2 Industry survey

When developing the survey, it was important to make the questions clear and easy for the respondents, as well as giving information that could be relevant for further development of the RECLAIM project initiative. Therefore, a questionnaire draft was developed in English. This questionnaire was sent to a RECLAIM project facilitator for review prior to a scheduled meeting. This person was also our contact person for the project. After receiving feedback regarding the survey from the project facilitator, the questionnaire was finalised, with some added questions from the RECLAIM-project team, and translated into Norwegian. These questions were added to Nettskjema, the digital solution chosen to make and send out the survey. The survey was sent out to a total of 17 companies that were provided by the RECLAIM project facilitator. To increase the number of respondents the students chose to research some marine industries in the county. By doing this roughly 10 more companies were found that the survey could be sent to. A reminder was sent out to the companies that did not respond to the first email regarding the survey. In addition to all of this, one of the team members lives in Møre and Romsdal, the county RECLAIM project is operating in. She had some insight to potential companies that could contribute to the survey and investigated some local ones to obtain direct contact information for the possibility to get more survey responses through the Nettskjema solution.

5. Results

5.1 Industry survey results

The survey was conducted in Norwegian, but the results were translated to English. The survey consisted of 10 questions, with the possibility of adding a personal comment after every question.

The first question in the industry survey was “Do you currently use recycled materials as raw materials?” The result of this question is presented in Figure 6.

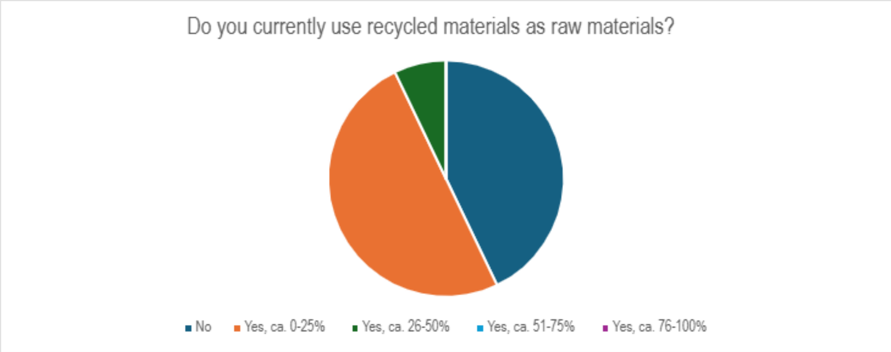

Figure 6: Results from question one of the industry survey.

The results show that most of the companies get 0-25% of their raw materials stem from recycled materials, with no companies utilizing recycled materials more than 76%.

The second question was “Do you source your raw materials from certified sustainable sources?”. The result of this question is presented in Figure 7.

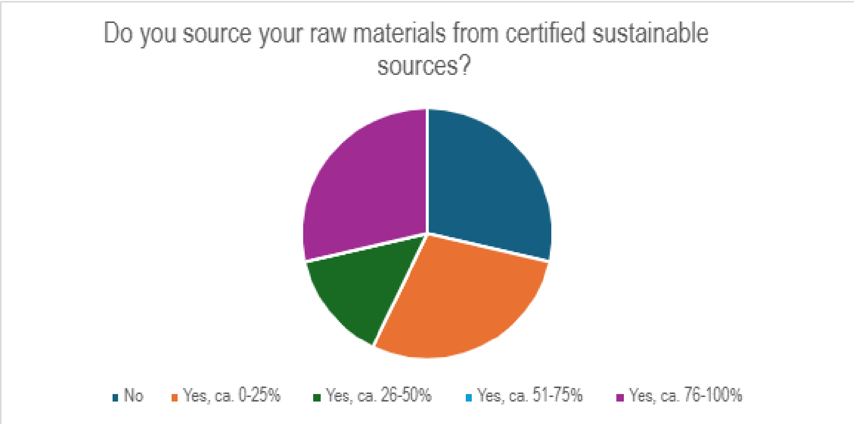

Figure 7: Results from question two of the industry survey.

The results show that more than half of the companies currently use raw materials from certified sustainable sources, only 25% of the companies utilize 76-100% of their raw materials frow certified sustainable sources.

The third question in the industry survey was “What do you do with the waste?” The result of this question is presented in Figure 8.

Figure 8: Results from question three of the industry survey.

The results show that in general there are good recycling practices in place in the area, with most of the companies focusing on the management of their own waste. As showed in the Appendix 3, some companies reported that they have different solutions for waste management depending on the type of waste. One company answered that they are already making new products with waste material. From the results we can see that upcycling is not yet common within the industry.

The fourth question in the industry survey was "Are you open to exploring upcycling as a waste management solution?" The result of this question is presented in Figure 9.

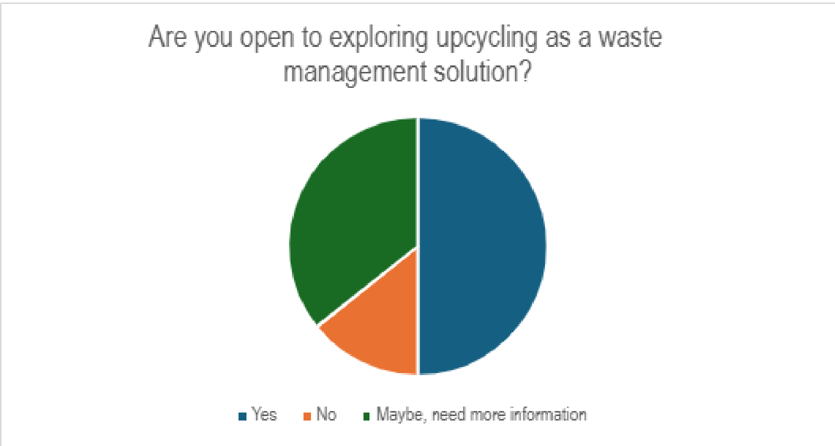

Figure 9:Results from question four of the industry survey.

The results show that there is a general interest into upcycling as a waste management solution, with half of the companies asking for more information.

The fifth question in the industry survey was "Do you have any upcycling programmes in place for your business?" The result of this question is presented in Figure 10.

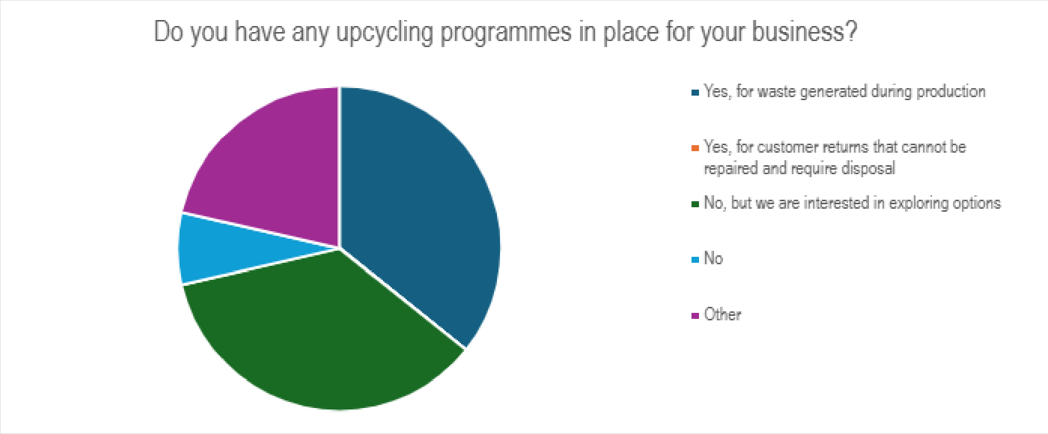

Figure 10: Results from question five of the industry survey.

The results show that most of the companies don't have upcycling programmes in place, with many of them open to explore options. There are practices in place for 30% of the companies regarding waste generated during production. For some companies none of the alternatives fit and for some more than one fit, which were stated in the comment section of the question (Appendix 3)

The sixth question in the industry survey was "What challenges do you foresee in implementing upcycling in your production process?" The result of this question is presented in Figure 11.

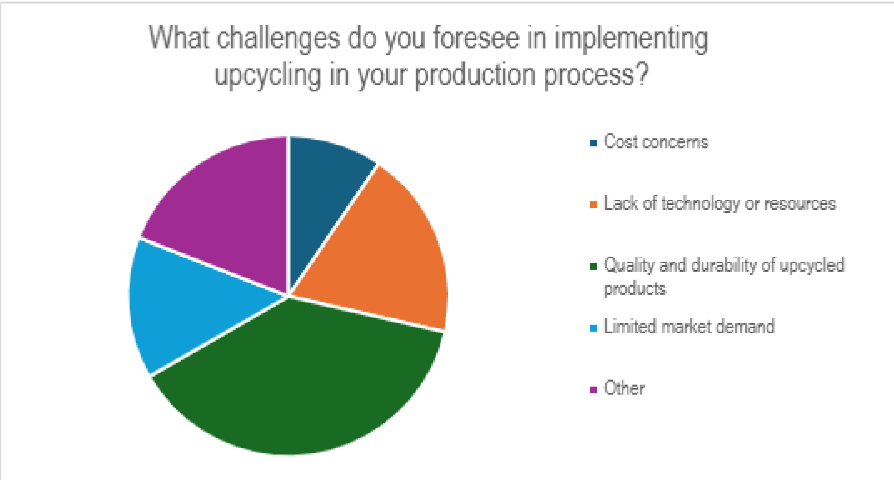

Figure 11: Results from question six of the industry survey.

As shown above the biggest challenge to upcycling is related to the upcycled product itself, with quality and durability concerns being raised. Another key challenge is the lack of technology or resources to process the materials, with one company reporting that hazardous waste has additional legal requirements that make it difficult to upcycle.

The seventh question in the industry survey was "Which of the following would help your company implement upcycling practices? (Select all that apply)" The result of this question is presented in Figure 12.

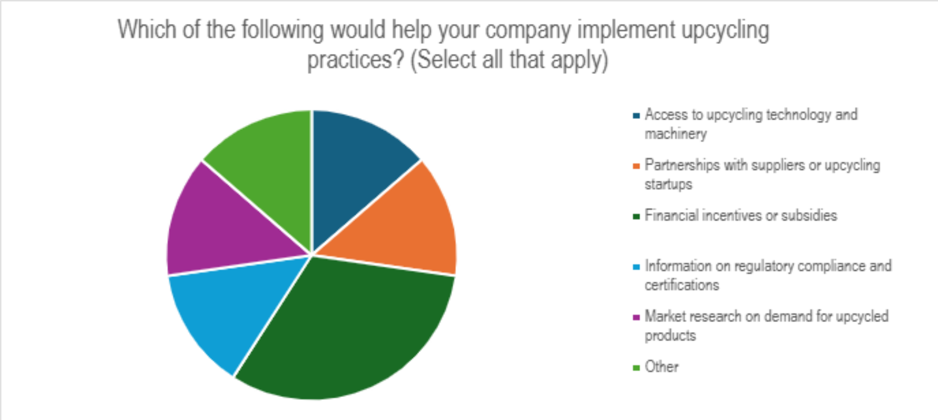

Figure 12:Results from question seven of the industry survey

As seen from the results, most companies would greatly benefit from financial incentives and subsidies to upcycle, seeing this as the biggest contributor to support upcycling practices. Availability of technologies and resources is also a key enabler for most of the companies involved in the survey. Some companies did not find this question relevant for them (Appendix 3)

The eighth question in the industry survey was "Would you require external support or technical knowledge to start upcycling?" The result of this question is presented in Figure 13.

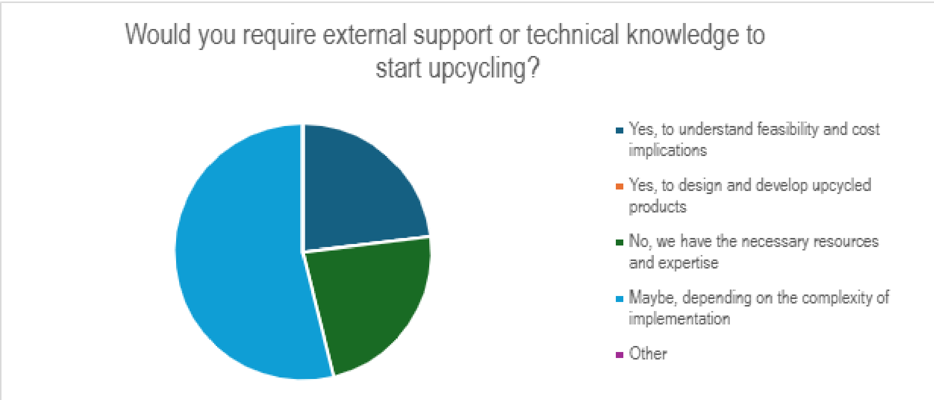

Figure 13:Results from question eight of the industry survey.

The results show that there is not a clear understanding of requirements and needs to implement upcycling, with most companies struggling to understand the implications of dealing with upcycling. One fourth of the companies answered that they have already the necessary resources and expertise, while assessing financial feasibility has been highlighted as one of the biggest challenges which will require external support.

The ninth question in the industry survey was "What timeline would be realistic for implementing upcycling in your company?" The result of this question is presented in Figure 14.

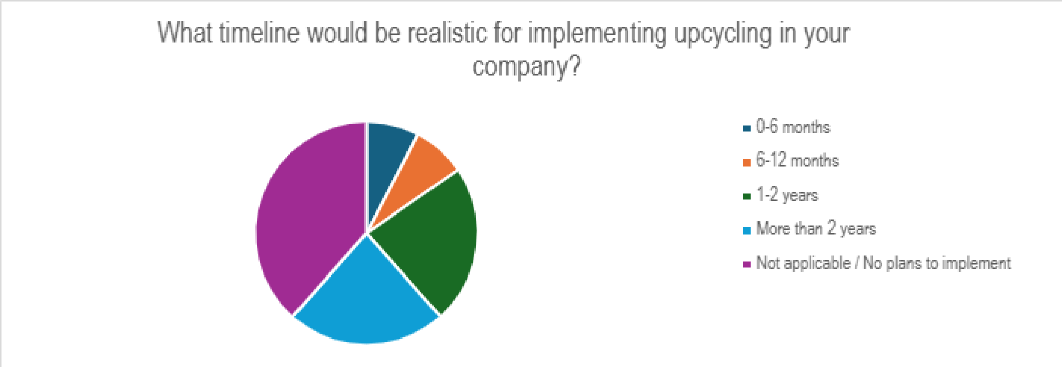

Figure 14: Results from question nine of the industry survey.

Most companies don't have any plans yet to implement upcycling, with one third suggesting a realistic timeline for upcycling implementation within two years or more.

The tenth question in the industry survey was "Which of the following upcycled product ideas would be useful for your operations?" The results of this question is presented in Figure 15.

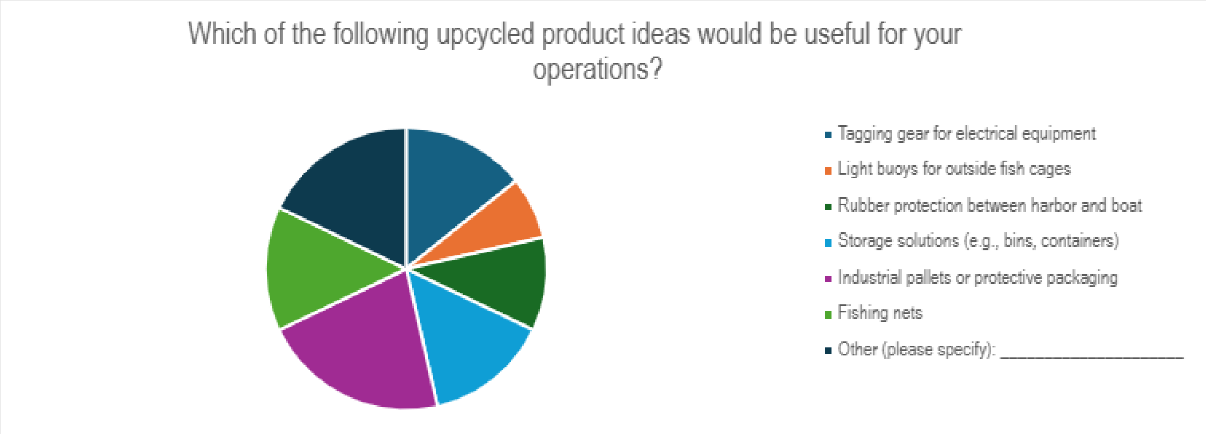

Figure 15: Results from question ten of the industry survey.

The results give an indication on what products the industry could be interested in made from upcycled products, with some companies reporting that none of the options provided would be useful to them (Appendix 3).

At the end of the survey there was an additional section where the companies could write if they had any further thoughts or suggestions regarding upcycling in their companies. These comments are presented in Table 3.

Table 3: Shows comments from different companies that were provided at the end of the survey. Both the original comments as well as a translated version is presented.

Norwegian	Translated to English
‘‘Marint avfall er i ofte ulik tilstand (degradert over flere år på havbunnen). Dette kan påvirke i hvilken grad man kan resirkulere/upcycling’’	Marine waste is often in different condition (degraded over several years on the ocean floor). This can affect the extent to which it can be recycled/upcycled
‘‘Et lite tips er at undersøkelsen inneholder mer informasjon om bedriften. Det gjør det lettere for dere å lage statistikk etterpå. Vi som ikke produserer noe vil "trekke" resultatet ned. Lykke til videre :)’’	A tip is that the survey contain more information regarding the company. This makes it easier for you to make statistics afterwards. We who does not produce anything will ‘‘drag’’ the results down. Good luck :)
‘‘Hei Vi har allerede mye bra på plass både i åpen og lukket kretsløp: materialgjenvinning av	Hi We already have a lot of good systems in order both in open and closed loops: Material

produksjonsavfall, retur av produktene våre, samt en resirkuleringsløsning for enklere produkter, som for eksempel Sporbart Miljøtau. Men det finnes en rekke produkter som ikke kan gjenvinnes, enten på grunn av manglende utvikling av tekniske prosesser, mangel på egnede anlegg, eller fordi nødvendig utstyr ikke er tilgjengelig. Vi jobber kontinuerlig med å endre dette i en mer bærekraftig retning. Positive endringer krever ressurser, tid og infrastruktur, som dessverre ennå ikke er fullt utviklet i regionen, Norge eller Europa.''	recycling of product waste, return of our products, as well as a recycling solution for simpler products such as traceable environmental rope. But there are a number of products that cannot be recycled, either due to the lack of development of technical processes, lack of suitable facilities, or because necessary equipment is not available. We work continuously to change this in a more sustainable direction. Positive change require resources, time and infrastructure which unfortunately is not yet fully developed in the region, Norway or Europe.
''Vi er et rederi som opererer world-wide. Det er krevende og dyrt å kjøpe lokalt og sende verden rundt. Vi forsøker å tenke og kjøpe lokalt når vi er i nærområdet.''	We are a shipping company that operates worldwide. It is demanding and costly to by local and ship around the world. We try to think and by local when we are in the area.

There were 4 answers out of 14 respondents for the last question. The comments show that some of the companies did not feel relevant for the survey. There were also some comments giving a reason for their answers and giving a more in dept explanation of the systems they already have implemented.

6. Discussion

6.1 Interdisciplinary work

After working together as a team, the members from each discipline have contributed well with their knowledge and skills to this project. Discussing together what the group have experienced, even though this project was outside most of our expertise, our observations showed that the two engineers were very effective in going straight to the point. The engineers were quick when solving problems and figure out solutions to them. This was especially in the context of the brainstorming phase, during the development of questions for the industry survey. One of the engineers was always already in the forefront of knowledge to present on group meetings regarding the project topic, which was useful when formulating the question in a way that gave the most information. One team member was used to conducting scientific studies and writing reports due to studies in "ocean resources". This was an advantage when structuring the research regarding our survey as well as the final report for the project and showed very helpful especially when handling sources and reviewing the report. Including this, marine pollution is a topic that has been touched upon in different courses for this group member, which brought some background knowledge regarding the project.

Two of the group members, one studying business and one information security management knew how to approach the "marketing and management" aspect. When sending out the survey, the members suggested that it was sent using a privately outlined email as well as formulating them with a more personal touch. As stated earlier in the report, the reasoning for this was that the originally sent survey was not received due to spam filters and being marked as suspicious. Although sending a separate mail to the companies took some time and was rather cumbersome, it showed effective since responses went from one to eight just over the course of a day. The group member studying business had also prior knowledge of businesses in Møre and Romsdal, which enabled us to reach more marine industry companies with our questionnaire. This increased the survey responses providing more data for the research.

6.2 Industry survey strategy

As shown in Appendix 1, the work package stated that the goal was to "Invite the aquaculture and fisheries industries to discuss the possibility to upcycle litter originating from their activities". The team's interpretation of the work package resulted in the creation of a survey, as stated in methodologies section (chapter 4).

In the development of the survey there were some discussions surrounding how to proceed and the group landed on making the survey in Nettskjema. The reasoning for this was that it is a secure website that does not retrieve your IP address and can be anonymous if desired. The team decided it was important in case some companies wanted to give an anonymous response. This strategy was decided to help lower the threshold for survey responses from companies receiving the survey. In the first week only one response was registered. The team received one email from one of the responding companies asking if the email sent out was legitimate because it looked suspicious. This was something that had been discussed could happen, and the group addressed the issue by sending out new emails to each company individually. This resulted in 7 more responses within a week. Since the survey response target was the offshore and marine industry, research on more companies was conducted to receive more answers from this industry sector. In Appendix 3 there are some comments regarding the relevance of the survey for some of the companies that responded to the survey. This could have been prevented if there had been done initial research on the companies and not relied only on the project facilitator. In the end the survey got 14 responses which gave sufficient data for the research.

The survey was translated from English to Norwegian to increase number of respondents due to the companies being Norwegian. Even though there are international workers in Norway, the project facilitator recommended the survey being in Norwegian and if necessary, google translate could be used for translation to English.

6.3 Industry survey results

The survey was open for one month. From the survey it was possible to see what different industries thought about the concept of upcycling and using upcycled materials. From the results there seemed to be some scepsis surrounding the implementation of these kind of systems. The strongest reason for not implementing upcycled products was due to the durability of the product. As mentioned earlier, there is high degradation of the litter in the sea (chapter 2.2). Therefore, by using the materials as it is, without any treatment, can lead to a product of lower quality and durability. This begs the question if upcycling is a good solution, or if recycling is more preferable. Looking at the waste hierarchy (Figure 5), it is desirable to create a product that can be sold for marked value, preferably without a lot of processing. This could be hard regarding upcycling for products that can be useful for the industries. In the survey there were listed some potential products that the team had come up with regarding upcycling. Excluding the ones that answered “other” on this question, there was most interest in “Industrial pallets or protective packaging” and “Tagging gear for electrical equipment”. How these products would be made could be determined with further research, but an idea could be to weave old fishing nets to a type of band that could be used as tagging gear.

6.4 Industry perspective on upcycling

The survey showed that the mindset of the industry in Møre and Romsdal were positive towards upcycling, and the green shift in general. Many industries are already using recycled materials today and are positive to continue using this. Upcycling is not that well implemented within the industries, and the survey shows that many industries are positive towards upcycling.

However, making an industrial business idea out of upcycling would be hard, as plastic waste have many different shapes and forms. Therefore, it is impossible to know what specific products one could create at a constant rate. There are possibilities for use within hobbies and art, as unique and creative shapes and usage could be valued at different times. However, distributing products towards industry is regarded as very difficult.

6.5 Incentives

During the project development it was discussed if government facilitated incentives could increase the appeal of implementing upcycling as a sustainable initiative in maritime industries. Incentives such as reduced taxes and similar measures such as carbon tax, which is a monetary fee to pay for each ton of greenhouse gas emitted, were suggested implementations to reduce unnecessary plastic over-production or increase marine litter utilization through upcycling. This is however an intricate topic and would require further research which is beyond the scope of this project. The concept of upcycling seems limited, but items mentioned in the survey, such as storage containers, Industrial pallets or protective packaging, and electrical tagging gear, are realistic products that could be examples of upcycled products also sustainable for the circular economy model.

6.6 Regulatory requirements

The regulatory requirements could be strict when it comes to durability of certain types of products both related to safety and usage if they are going to be upcycled. This could be an obstacle or limitation depending on what the upcycled products are going to be used for, or what industry it is going to be applied to. This is something that needs to be taken into consideration towards the possibility of upcycling certain types of items and products.

In the end, the question that also needs to be asked are if upcycling is an effective way of reducing waste and pollution in the ocean, or if it only extends the lifecycle of products for a little while. Will the same amount of plastic waste be present in the ocean when it breaks down after being upcycled anyways?

6.7 Technology and upcycling

As written in the technology section (chapter 2.6). Using advanced technology for innovative recycling methods, automated sorting and recycling systems helping with sophisticated recycling processes could assess whether products could be upcycled or not. This could be a benefit towards the implementation of upcycling marine litter in the waste industry. Advanced robotics and artificial intelligence could also use algorithms, scanners and sensors to determine if plastic products are durable enough to either still be used for its intended industry purpose or upcycle/reuse it in a way that it increases its utility or value. Is it for example possible and economically viable to effectively repurpose fibres from plastic ropes into fishing nets or vice versa?

6.8 Community engagement

Despite the fact that upcycling does not seem to be the easiest or best initiative for companies to implement in their business model, it could be used as a form of creating awareness surrounding plastic pollution in the ocean as well as on land. As briefly stated in the Recycling and Upcycling section, using tools and materials to create art with waste would be a type of product upcycling (chapter 2.4Recycling & Upcycling). With the right form of presentation, it would benefit the education of younger generations to understand the implications of marine waste in the costal environment. This could also create a space for artists to practice their art as well as engaging local community platforms to raise awareness to tourists and visitors with galleries and spaces hosting upcycled art.

7. Conclusion and further research

In conclusion, while upscaling marine litter solutions requires initial financial commitment, circular economy approaches offer long-term value. They reduce costs, unlock new markets, mitigate regulatory risks, and improve investor appeal, making them not only environmentally necessary but also financially viable for the aquaculture and fisheries industries.

Based on the research done in this report there are some limitations regarding upcycling for industrial purposes, so recycling might be a better option when making new products for the industries. Concerns regarding the state of the plastic waste to be upcycled is the biggest challenge. The plastic waste might be of vastly different shapes, could consist of many types of material as well as being degraded through their original lifecycle. Upcycling is a good alternative for less durable products such as plant pots and art, where the possibilities are "limitless". However, the team believe it will be too challenging to develop industrial products made of upcycled plastic waste at this current state.

In general, there is a big potential for improvement in the tackling of marine litter. Further research should be conducted to locate and understand the limitations and potential for companies to utilize more recycled or upcycled materials. Even though the conclusion of this report leans towards upcycling being an unfavourable method to prolong the life of plastic waste, further research could conclude otherwise. If more resources are being investigated, unforeseen upcycling possibilities could be discovered. The industries attitude towards upcycling is positive, they might just miss the correct hidden path ahead.

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9. AI declaration

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Have any AI-based aids or tools been used in the creation of this report?

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- [x] Yes

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- [x] **Text generation.** Are parts of the text generated by: *ChatGPT, GrammarlyGO, Copy.AI, WordAi, WriteSonic, Jasper, Simplified, Rytr* or similar tools?
- [ ] **Writing assistance.** Are one or more of the reports ideas or approach suggested by: *ChatGPT, Google Bard, Bing chat, YouChat* or similar tools?

If *yes*, use of text aids/tools apply to this report - please specify usage here:

AI tools have been used when writing the final report to improve the grammar and sentence structure, the team agreed on never simply copy and past from AI tools but only use it as reference and support

Codes and algorithms

- [ ] **Programming assistance.** Are parts of the codes/algorithms that i) appear directly in the report or ii) have been used to produce results such as figures, tables or numerical values been generated by: *GitHub Copilot, CodeGPT, Google Codey/Studio Bot, Replit Ghostwriter, Amazon CodeWhisperer, GPT Engineer, ChatGPT, Google Bard* or similar tools?

If *yes*, use of programming assistance aid/tools apply to this report - please specify usage here:

Images and figures

- [ ] **Image generation.** Are one or more of the reports images/figures generated by: *Midjourney, Jasper, WriteSonic, Stability AI, Dall-E* or similar tools?

If *yes*, use of image generator aids/tools apply to this report – please specify usage here:

- [ ] **Other AI aids or tools.** Have you used other types of AI aids or -tools in the creation of this report? If yes, please specify usage here:

- [x] I am familiar with NTNU's regulations: *Submitting a report generated with the assistance of AI tools and claiming the work to be partially or fully my own, is not permitted. I therefore declare that any use of AI aids or tools are explicitly stated i) directly in the report or ii) in this declaration form.*

Øystein F. Gundersen, Kenneth Bjørlund, [signatures] 23/04/25 Floro (NO) 28/04/25 Trondheim

Signature/Date/Place

10. Appendix

Appendix 1

The appendix shows the different work packages that was given from the project facilitator from the RECLAIM project. The highlighted work package is the one that this team was given:

<u>Workpackages</u>

WP1. Engage the Community

Task 1.1: Partnership Development: Collaborate with environmental and community groups to organize joint clean-up events. Provide these organizations with resources and training to use the PlastOPol app for data collection during clean-ups. Support these organizations in hosting educational workshops or information sessions about the importance of maintaining clean marine environments.

Encourage local businesses to sponsor clean-up events, provide resources, or engage their employees in volunteer days. This task seeks to discover new and effective methods for local collaboration and corporate engagement, significantly impacting sustainable development, as outlined in the section below. Work with local government officials to integrate marine litter management into municipal waste policies and public works projects.

Task 1.2 Awareness Campaigns: Launch a campaign through social media, local media, and community outreach to raise awareness about the Mission Ocean Charter, SeaClear2.0, and RECLAIM, as well as the impact of marine litter and public contribution to mitigation efforts. RECLAIM will coordinate at least two regional beach clean-ups in collaboration with volunteer organizations. Participants will be encouraged to use the PlastOPol app for reporting marine litter sightings and data collection, thus boosting community engagement.

WP2. PlastOPol App and Model

Task 2.1 Citizen Science – Data Collection:

Organize workshops to train volunteers on using the PlastOPol app for effective data collection on marine litter, including its quantity and origin. Motivate the community to use the app and contribute data, offering real-time feedback on their impact. Utilize existing smart city programs and citizen engagement frameworks across partner cities to implement this work package efficiently. Collaborate with the Norwegian University of Science and Technology (NTNU) to enhance our model's ability to detect underwater litter using sophisticated training with both existing and newly collected data. NTNU will refine the model to improve hotspot mapping, source identification, and statistical analysis, which will be beneficial when the SeaClear2.0 technology is tested in the region. We will develop this in close collaboration with the SeaClear2.0 team to ensure compliance and integration. Showcase the SeaClear2.0 project and the PlastOPol model's progress and capabilities at community events or through online platforms to maintain engagement and interest.

WP3. Upcycling Marine Litter

Task 3.1 Industry involvement: Invite the aquaculture and fisheries industries to discuss the possibility to upcycle litter originating from their activities. This could be lost fishing gear, lost fishing pods, buoys etc. or other plastic items.

Task 3.2 Upcycling Pilot Projects: Initiate future pilot projects to test the feasibility of repairing, refurnish or remanufacture items and hereby contribute to strategies in circular economy.

Task 3.3 Collaborative Projects: Develop collaborative projects that involve the industry and NTNU in funding or supporting upcycling initiatives.

RECLAIM benefits from collaborations with existing regional organizations that are already combating marine litter, such as “Friluftsrådet”, “Runde Environmental Centre”, “Stikk Ut” and “Stiftelsen Miljøfyrtårn”. Additional partnerships include local fishing and aquaculture industries, city harbors, waste management companies, and others with a culture of joint action against pollution. Together with voluntary organizations like “Nettverk Marin Forsøpling Møre og Romsdal”, “Hold Byen Ren”, and “Plastfritt Hav”, significant progress has been made in cleaning marine litter from the shoreline.

Appendix 2

This appendix shows the industry survey that was sent to the companies:

Nettskjema

Potensialet for upcycling i industriene i Møre og Romsdal

Hei, og velkommen til denne undersøkelsen! Målet vårt med denne undersøkelsen er å utforske potensialet for *upcycling* i industrinene i Møre og Romsdal kommune. Vi er en gruppe med studenter fra NTNU som har faget Eksperter i Teams, og sammarbeider med RECLAIM-prosjektet. RECLAIM-prosjektet har som mål å redusere tap av utstyr og maritin forsøpling langs kysten i Møre og Romsdal, i tillegg til å forbedre ressursbruken ved avfallshåndtering. Vi ønsker å få en bedre forståelse rundt dagens praksis ved å identifisere muligheter for innovative *upcyclede* produkter i industrien.

Upcycling definisjon:
Gi nytt liv til gamle produkter og materialer ved å omforme dem til noe annet som er like, eller mer, verdifullt.

Navn på bedriften

E-postadresse

Bruker dere for tiden resirkulerte materialer som råvarer?

Nei
Ja, ca. 0-25%
Ja, ca. 26-50%
Ja, ca. 51-75%
Ja, ca. 76-100%

Skaffer dere råvarene fra sertifiserte bærekraftige kilder?

Nei
Ja, ca. 0-25%
Ja, ca. 26-50%
Ja, ca. 51-75%
Ja, ca. 76-100%

Hva gjør dere med avfallet?

Kastes som avfall
Resirkulere
Upcycle
Annet

Om annet, venligst spesifiser.

Er dere åpen for å utforske *upcycling* som en avfallshåndteringsløsning?

Ja
Nei
Kanskje, trenger mer informasjon

Har dere noen *upcycling*-programmer på plass for din bedrift?

Ja, for avfall som genereres under produksjonen
Ja, for returvarer fra kunder som ikke kan repareres og krever avfallshåndtering

Nei, men vi er interessert i å utforske alternativer
Nei
Annet

Hvis annet, vennligst spesifiser.

Hvilke utfordringer ser dere for dere ved å implementere *upcycling* i produksjonsprosessen deres?

Kostnadsbekymringer
Mangel på teknologi eller ressurser
Kvalitet og holdbarhet på upcyclede produkter
Begrenset etterspørsel i markedet
Annet

Hvis annet, vennligst spesifiser.

Hvilke(t) av følgende alternativer vil hjelpe deres bedrift med å implementere *upcycling* i praksis? (Velg alle som passer)

Tilgang til upcycling-teknologi og maskineri
Partnerskap med leverandører eller upcycling-startups
Økonomiske insentiver eller subsidier
Informasjon om overholdelse av regelverk og sertifiseringer
Markedsundersøkelse av etterspørsel etter resirkulerte produkter
Annet

Hvis annet, vennligst spesifiser.

Vil dere trenge ekstern støtte eller teknisk kunnskap for å starte med *upcycling*?

Ja, for å forstå gjennomførbarhet og kostnadsimplikasjoner
Ja, for å designe og utvikle upcyclede produkter
Nei, vi har nødvendige ressurser og kompetanse
Kanskje, avhengig av kompleksiteten i implementeringen
Annet

Hvis annet, vennligst spesifiser.

Hvilken tidslinje ville være realistisk for implementering av *upcycling* i deres bedrift?

0-6 måneder
6-12 måneder
1-2 år
Mer enn 2 år
Ikke aktuelt / Ingen planer om å implementere

Hvilke av følgende *upcyclede* produkt-ideer vil være nyttige for bedriften deres?

Merkeutstyr for elektrisk utstyr

Nettskjema

Lysbøyer for å ha ute ved fiskemerder
Gummibeskyttelse mellom havn og båt (fendere)
Lagringsløsninger (f.eks. bokser, containere)
Industrielle paller eller beskyttende emballasje
Fiskegarn
Annet

Hvis annet, vennligst spesifiser.

Har dere flere tanker eller forslag angående *upcycling* i deres bedrift?

Appendix 3

This appendix shows the comments that were written after the different questions of the survey:

Question	Answer	Original comment	Translated comment
Q3: "What do you do with the waste?"	Other	"Sender det til Hofseth Biocare for å lage nye produkt."	Sends it to Hofseth Biocare to make new products
	Other	"Kildesorterer"	Source separating
	Recycled	"Her må det være mulig med flere kryss. Vi har sortering av det som er mulig, noe restavfall og risikoavfall til destruksjon"	Here it has to be possible with several crosses. We have sorting of what is possible, some residual waste and hazardous waste for destruction.
	Recycled	"Vi kildesorterer, men vi bruker også om noko av bygg, vanntankar, hallar o.l."	We Source separate, but we reuse also buildings water containers, halls, etc.
	Recycled	"Avfallet blir levert og sortert på Materal- og energigjenvinning, samt deponi."	The waste is delivered and sorted at material and energy recycling as well as landfill.
Q5: "Do you have any upcycling programmes in place for your business?"	Other	"Vi har interne bærekraftsmål med økt resirkulering i fokus"	We have internal sustainability goals with increased recycling in focus.
	Other	"Flere prosjekt med gjenbruk av tyngre masser (blåsesand, sandfag/gateoppsop)"	Several projects either reuse of heavier materials (blasting sand,

			sweepings/street sweeping)
	Yes, for waste generated during production	"Passer med begge varianter. Både: Ja, for avfall som genereres under produksjonen og Ja, for returvarer fra kunder som ikke kan repareres og krever avfallshåndtering"	Fit both variants. Both: Yes, for waste generated during production and Yes, for customer returns that cannot be repaired and require waste management
Q7: was "Which of the following would help your company implement upcycling practices? (Select all that apply)"	Other	"Systemer som finnes er gode nok for det som kan gjenvinnes"	Existing systems are good enough for the things that can be recycled
	Other	"Vi er ikke noen produksjonsbedrift"	We are not a production company
Q10: "Which of the following upcycled product ideas would be useful for your operations?"	Other	"Ingen av svarene passer"	None of the answers fit
	Other	"Vi er ikke noen produksjonsbedrift"	We are not a production company
	Other	"Ingen av desse"	None of these
	Other	"Generelt er det å finne nye veier Deponiprodukt, som løfter de opp i det sirkulære hierarkiet"	In general it is about finding new ways to landfill products, which elevate them up the circular hierarchy
	Storage containers, fishing net	"Mye forskjellige. Hvert produkt må ha sin egen løsning og system"	A lot of different things. Each product must have its own solution and system