BREAKING OUT

ANCHORING CIRCULAR INNOVATION FOR SHIP RECYCLING

ABOUT US

NGO SHIPBREAKING PLATFORM

The NGO Shipbreaking Platform is a coalition of environmental, human and labour rights organisations working to promote safe and environmentally sound ship recycling globally. The Platform was first created in September 2005 after the few NGOs working on the issue noticed that a broader base of support, a stronger network of organisations from ship-owning and shipbreaking countries, and a long-term approach were needed to challenge the political clout of the shipping industry.

The coalition quickly evolved from being a European Platform to a global one, including NGOs based in the major shipbreaking countries India, Bangladesh, Pakistan and Turkey. It now has 17 member organisations and ten partners in 12 countries. The Platform is recognised by United Nations agencies, the European Union and leading media outlets as the preeminent international civil society advocacy organisation on ship recycling.

VISION
Our vision is that vessels are recycled in facilities that ensure clean, safe and just practices, offering decent and safe jobs. Our commitment to finding sustainable global solutions is based on the respect for human rights and the principles of environmental justice, producer responsibility, 'polluter pays' and clean production.

MISSION
To advocate for clean, safe and just ship recycling globally in respect of human rights, core labour standards and environmental justice, and for the prevention of dirty and dangerous practices, such as the dumping of end-of-life vessels on the beaches of developing countries.

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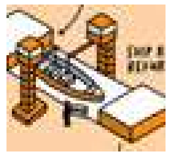
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EDITORIAL

SHIPBREAKING PLATFORM TEAM

On behalf of the NGO Shipbreaking Platform, we are excited to launch this first edition of Breaking Out. In these pages and together with the convening of our first Ship Recycling Lab in Rotterdam this September, we aim to connect the people and enterprises that are pioneering a new future for sustainable and ethical ship recycling.

There are many reasons to be optimistic and to bet on the innovators we profile in this edition. They are convinced that responsible ship recycling can compete and that the time is ripe for radical change. Backed by an industrial and political shift to a circular and low-carbon economy in Europe, they are seizing new opportunities for innovation created by the momentum for green and regenerative design, production and end-of-life management.

Breaking the global fleet on tidal beaches in India, Bangladesh and Pakistan causes irreversible damage to workers and the environment. Greenwashing incremental changes on these beaches is not the solution, especially when alternatives already exist. Breaking Out disrupts the short-sighted discourse that has dominated and held back real progress in the ship recycling sector for too long and showcases technologies ranging from automation and robotics to the age-old, tried and true use of dry docks for safe and fully contained recycling.

Highlighting cradle-to-cradle design concepts, circular business models, zero-carbon steel making processes, and ways to close the gap between the building and recycling of ships, Breaking Out also addresses why a just transition into an equitable circular economy is needed. We even dare to include de-growth as part of the solution.

Our venture into circularity has come with a collaborative mindset, eager to discover new ideas and partners. In this edition, we only scratch the surface as each day has introduced us to new projects and innovators. This has proved incredibly encouraging. There will clearly be more to report in the future, also because a wave of end-of-life ships will be heading for recycling in coming years as green technologies replace those in older vessels.

We invite you to take note of the exciting opportunities for the future of sustainable ship recycling that are discussed in these pages and thank all of you who have supported the creation of this magazine!

INGVILD JENSSEN DIRECTOR OF THE NGO SHIPBREAKING PLATFORM
& **HELEN PERIVIER** PRESIDENT OF THE BOARD OF DIRECTORS

IN TRANSIT TOWARDS A SUSTAINABLE CIRCULAR ECONOMY: SHIPS, STEEL AND ETHICS

BY HELEN PERIVIER

Businesses and governments are gearing up to join a circular economy, a transformative endeavour with ambitious goals for the environment and the economy. For the shipping sector, the transition to a circular economy has the potential to change how ships are designed, maintained and recycled, even how they are owned and valued. The anticipated building of ships with low carbon technologies and the increasing number of ships heading to the scrap yard create both opportunities and urgency for circular innovation. However, political and social scientists warn that without greater emphasis on social and political dynamics, the circular economy will exclude vulnerable populations and fail to slow the global consumption of resources. Instead, they say a just transition must be inclusive and equitable to achieve an ethical and sustainable circular economy.

CIRCULARITY ON THE HORIZON

The maritime sector, as the world's major transporter, will have to adapt to the new trade patterns and restructuring that will emerge in the transition to the circular economy.

Already, vulnerabilities exposed by the recent pandemic have motivated efforts to develop more resilient ports and supply chains, according to the UNCTAD Review of Maritime Transport 2021. These resilience measures include digitalisation to monitor supply chains and better exchange information between suppliers, customers and partners, nearshoring and regionalisation for more robust supply networks, and commitments to lower carbon footprint and reduce waste. As these trends develop, so will opportunities to boost circularity in ports and supply chains.

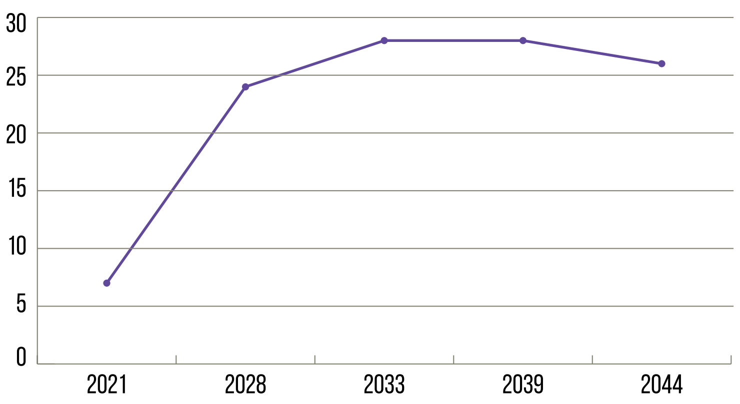
The demand for zero-carbon emissions further creates openings to integrate circular technologies in the building of new ships, although this will also lead to early scrapping of older vessels. An analysis of fleet renewal trends estimates that global recycling volumes will double by 2028 and near-quadruple by 2033, reports the Sustainable Shipping Initiative.

Current initiatives for a carbon-neutral steel industry also create openings to introduce circularity into shipbuilding and recycling alike, and could perhaps bridge the gap between these two phases of a ship's life cycle.

Meanwhile, efforts to address social sustainability in the climate transition may serve as models and provide synergies to help the most vulnerable groups who will be impacted by the transition to the circular economy.

The EU Taxonomy for sustainable activities identifies building of low emission vessels as a sustainable activity to finance and also identifies under the Do No Substantial Harm principle that if this activity (building of a new low emission ship) entails the scrapping of a more polluting one, the latter should be recycled in an EU-listed facility to ensure that the goal of circular transition is not hampered by the goal of climate mitigation.

PROJECTION : ANNUAL SHIP RECYCLING CAPACITY IN LDT (LIGHT DISPLACEMENT TONNAGE) - MILLIONS



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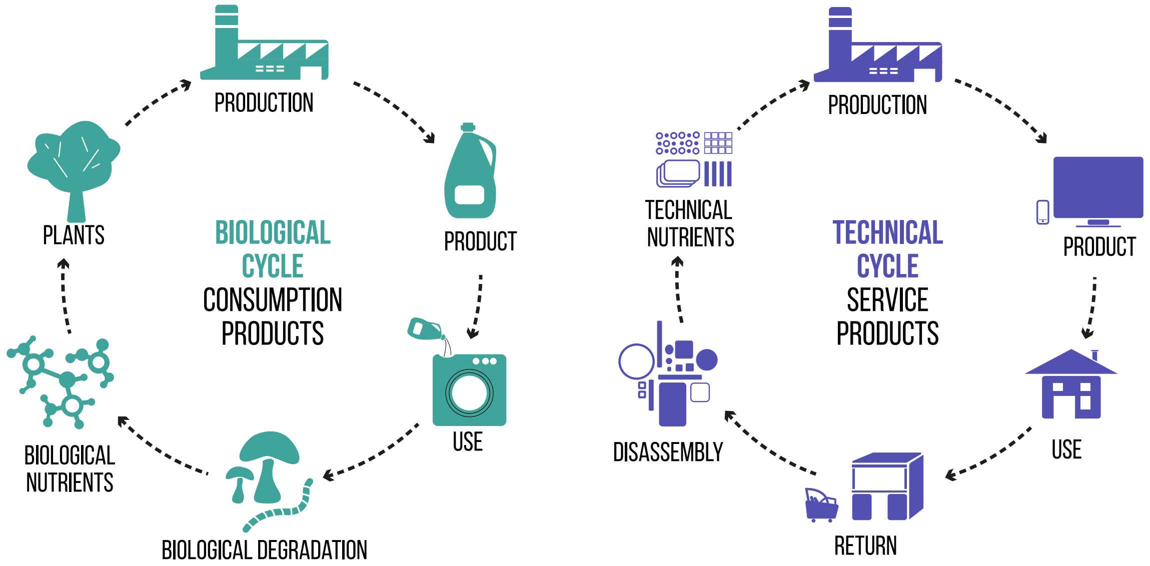

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VALUE BY DESIGN

EcoCab

Innovating maritime circularity, Prof. Dr. Michael Braungart and researcher Kamila Szwejk at Leuphana University Lüneburg (Germany) are partnering with Meyer Werft, German shipbuilder of cruise vessels (for the Carnival corporation, among others), to create a prototype of an entirely 'circular' cruise ship cabin.

EcoCab is a project funded by the German Federal Ministry for Economic Affairs and Energy (BMWi) to develop a self-sufficient and sustainable, low-energy cruise ship cabin, not simply to be recyclable, says Szwejk, but "to completely rethink a ship's cabin" and design the cabin and its components according to the Cradle-to-Cradle concept, which includes healthy and recyclable products and materials that can be reused. The project envisions that a circular ship's cabin could in the future be designed to allow for its continued use in affordable housing.

As a prototype for a cruise ship cabin, EcoCab develops circular models that can be applied across the whole ship, and the cruise ship in turn becomes a prototype for other ships. "When you can do it with a cruise ship, which is highly complex, it can be done much more easily for any type of containership as well", says Braungart.

The EcoCab cabins are designed to use safe materials and Cradle-to-Cradle certified products for carpets, insulation and furniture and will be powered by photovoltaic tiles, Szwejk explains. "A Cradle-to-Cradle cabin will be designed in a way that all components used in it can either enter the biosphere or the technical sphere again. Therefore, no waste is generated and the raw materials used do not get lost," she says.

In presenting the EcoCab project it is clear that Braungart is thinking about much more than ship cabins. It was he, together with architect William McDonough, who in the 1990s developed the Cradle-to-Cradle foundation for the circular economy. As he says: "We have a material problem because there are not enough meteorites coming in that will help us with more chromium or nickel or cobalt and all the other elements. So we need to design things differently for a clear design for disassembly."

"There was never a car made into a car. It's always been downcycling [the values of the materials]. And we lose rare trace metals like chromium, nickel, cobalt, titanium and manganese. They all get diluted in concrete reinforcement steel". Braungart has worked with BMW to make cars from cars, and the company has announced that by 2050 it will make the first car entirely using materials from its end-of-life cars.

"Finding markets for components of a scrapped ship besides the steel would be easier if ships were designed for dismantling and value retention", says Bert van Grieken, commercial director of Sea2Cradle, a ship recycling consultancy firm. He continues, "In newer vessels, such as cruise liners like Carnival, waste and recycling are less straightforward. There is so much stuff on board. Ship recycling is really not up to the challenge, and much of the interior is broken to waste. To change we need to go into building and designing, taking interior materials into account so you can save as much as possible from the dismantling process with modular design. In practice building and repair are very separate from recycling. It would be good if ship-builders and recycling were together."

"In the maritime sector, for us the first partner is the shipbuilder. Cradle-to-Cradle design is an opportunity for true innovation and competitiveness, and this is why this project is interesting for the shipbuilding company," Braungart continues, noting that cruise ships are only built in a few places in the world, due to their complexity. Braungart has built a long-term relationship with ship builders Meyer Werft, "a family-owned company that wants to be proud of what they are doing", and helping the company identify trends and new innovation opportunities.

The EcoCab project reflects the collaborations underlying innovation and circularity. "It combined different methods and involved an interdisciplinary team," says Szwejk.

Meyer Werft is in overall charge of the project, while the EcoCab partners DLR Institute for Networked Energy Systems, Fraunhofer Institute for Building Physics and MAC Hamburg are responsible for developing new technical cabin systems with a focus on energy efficiency. This includes the development of a decentralised photovoltaic system on the cabin balcony, a decentralised air conditioning system and a digital twin of the cabin. This process is accompanied by the consideration of socio-ecological aspects. The Cradle-to-Cradle certification and consulting company EPEA, which belongs to Drees & Sommer, is concentrating together with Leuphana University on the development of the material database and the integration of new Cradle-to-Cradle developments and perspectives into the processes. Life cycle assessment is primarily carried out by DLR, but with the participation of all partners.

"With a Cradle-to-Cradle approach", Szwejk adds, "we look at the entire life cycle of a ship cabin and thus also the topic of recycling. We therefore deal with alternative business models and take-back systems for the components. As part of that, we had a closer look at the ship recycling industry in general."

Material Passports

A material passport is essential to understand and retain the value. A material passport, also referred to as a products or circularity passport, is a data set describing the characteristics of the materials and components in a product or system that give them value for present use, recovery, and reuse (Heinricht & Lang, 2022).

While material passports have been used in the construction industry, they are relatively new to the maritime sector, although not without precedent. In 2014, Maersk announced a plan to create a Cradle-to-Cradle materials passport for their new Triple-E ships. The passport would account for 95% of the ship's weight and "every nut and bolt of the ship, making recycling possible for most materials and safe disposal of the rest". The company's materials passport was to follow the ship over its lifetime and be updated with the active involvement of some 75 suppliers. Despite uncertainties on the status of the project, this first step for a material passport by one of the largest shipping companies is noteworthy and shows the potential for innovating digital means to trace material flows in the maritime sector.

For the EcoCab project, identifying all the components and materials of a ship cabin was a first step, says Szwejk, and "a very, very big task because the information is spread across different departments and information from suppliers is not always easily accessible."

"When we know at some point in the future which materials are installed in the ship and where, we can create a material passport for the ship, and then we can say, okay, now the ship itself can function as a material bank. But there is still a long way to go until then. In EcoCab, we have tried to collect all the materials used in a ship's cabin for the first time."

	INVENTORY OF HAZARDOUS MATERIALS	MATERIAL PASSPORT
MATERIAL COVERAGE	ONLY HAZARDOUS MATERIALS	ALL THE MATERIALS THAT ARE INCLUDED IN A PRODUCT OR CONSTRUCTION
MATERIAL SUPPLIERS TRANSPARENCY	NO INFORMATION PROVIDED	TRACING OF SUPPLIERS DETAILS, CERTIFICATIONS, BRAND NAME AND MANUFACTURERS
FOCUS	REMOVAL AND TREATMENT OF HAZARDOUS MATERIALS	RECOVERY OF ALL COMPONENTS AND MATERIAL
RESEARCH METHOD	VISUAL CHECKING AND SAMPLES	SOFTWARE SOLUTION

Today, many ships carry an Inventory of Hazardous Materials (IHM), which lists hazardous materials used either during the ship's construction or acquired over its lifetime, and their location and quantities onboard. The IHM informs the removal and treatment of hazardous wastes during ship recycling. A material passport, meanwhile, focuses on recovering and retaining components and materials to keep them out of the waste stream from the start.

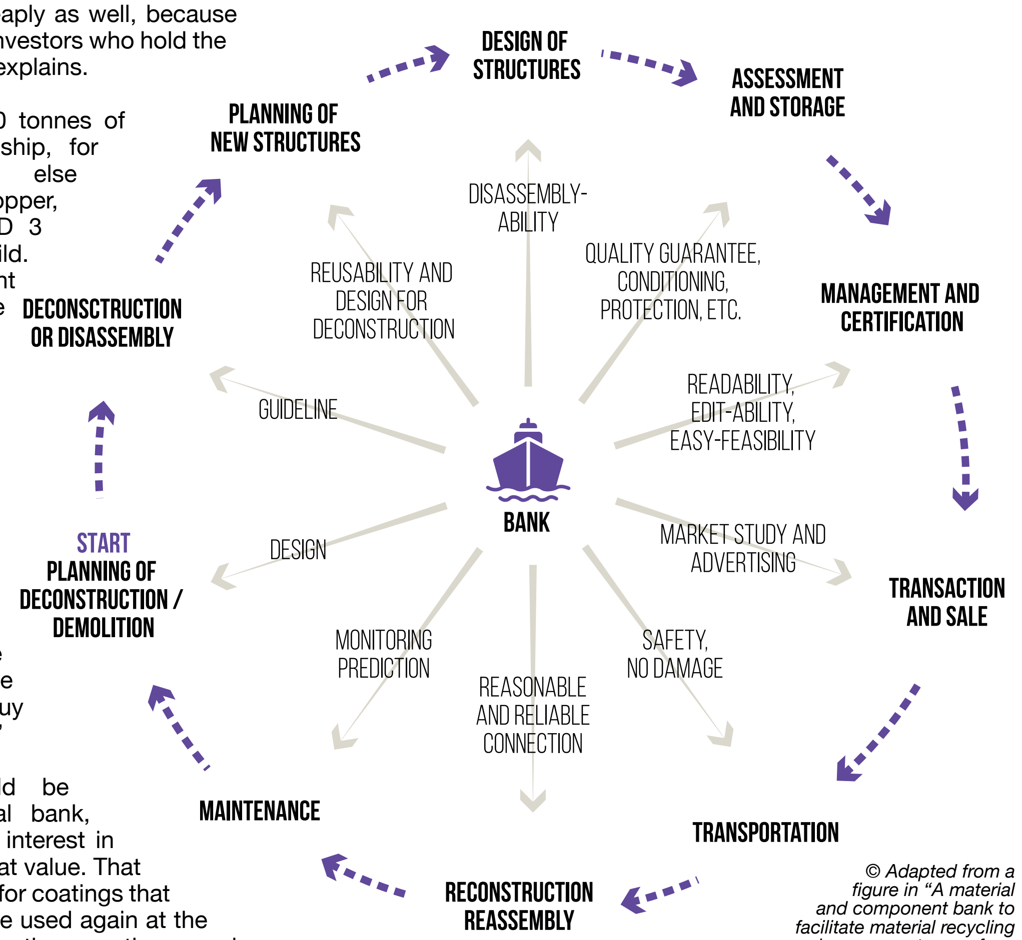
Material Banks

Treating the ship as a material bank is one way to close the material loop in the future and carry out effective ship recycling. The retention of materials and values could revolutionise material flows and even how ships are owned. "Basically, a ship can become a materials bank, which would allow it to be made much more cheaply as well, because you could have extra investors who hold the materials," Braungart explains.

"If there were 3 000 tonnes of copper in a cruise ship, for example, someone else might own that copper, making the ship USD 3 million cheaper to build. A shipowner might pay an interest rate of 3% or 5% for use of the copper over the lifetime of that ship, which would then be reclaimed at end-of-life. In essence, there would be a strong interest in retaining the copper for future use. But that would require another business model, where you no longer buy the material, you only buy the service of using it."

The material would be owned by a material bank, which would have an interest in the design retaining that value. That is why you would look for coatings that allow the material to be used again at the highest level, and why the way the vessel can be disassembled becomes crucial so it can be done by robots and not contain toxic materials.

Closing gaps between ship recycling and shipbuilding could allow the creation of high-quality jobs and "to change the design of ships dramatically because you can then use the best materials, not the cheapest ones", says Braungart.



© Adapted from a figure in "A material and component bank to facilitate material recycling and component reuse for a sustainable construction: concept and preliminary study" by Gaochuang Cai et al / Springer Nature

A PERSPECTIVE FROM THE BUILDING SECTOR

As someone working on sustainability in the built environment, architect David Johnson, Principal at SERA Architects and a leader in regenerative design, sees some advantages for the maritime industry compared to the construction and demolition sector.

“Construction waste from buildings has many diverse sources that are then incoherently pooled in the urban environment, leaving it to the locality to deal with the recovery of the resources”, he observes.
“My perception is that the supply of the materials and the products that go into ships is from a more defined set of sources.”

The construction industry, on the other hand, appears more advanced than the maritime sector in adopting circular practices. Digital systems for material passports are already in the works, such as the Electronic Materials Passport developed by the Buildings as Material Banks (BAMB) program. The BAMB passport includes information on materials (chemical composition, hazard statements, recycled content, sourcing statements), and design for dismantling and re-use.

Other initiatives include Toxnot’s Product Circularity Data Sheet (PCDS) system, which allows companies to document the circularity of their products, and the Healthy Product Declaration Collaborative (HPD-C), a building industry member organisation which maintains a standardised system for product manufacturers and ingredient suppliers to disclose information about their products and associated health information.

Such digital material documentation systems help companies retain value, improve efficiencies, extend product lifetimes and optimise product use throughout their supply chain, says Johnson. “What if the shipping industry said it wanted ships to have a Product Circularity Data Sheet by 2025? How many suppliers do they have?” asks Johnson.

“Learning from Product Circularity Data Sheets or Material Passports shows there needs to be a dialogue between the user and the producer going up and down the supply chain,” says Johnson. “You need to start a dialogue that doesn’t exist. You need to make people aware of the value so they know that if 50% of the ship is not recovered then 50% of the Gross Domestic Product (GDP) that went into the ship is lost forever.”

“And some of these rare earths and these metals materials, our next generation is going to want them back. People are now mining landfills that date back to the era when computers were simply put into landfills because it’s cheaper to recover,” says Johnson, referring to the process of excavating and reclaiming valuable materials from landfilled waste. “People are buying futures on landfills from certain periods when Apple computers were being thrown away and before there was recovery of those computers, because it’s cheaper to recover those materials than to mine the primary resources.”

“The value of a materials passport is that we can recover the steel and be assured of its quality. If you can’t prove that it’s high-grade steel, it’s going to be assumed it’s scrap.” Referring to the carbon embedded in the life cycle of construction materials, including mining, processing, manufacturing, transportation and installation, Johnson adds: “Steel that was produced in regulatory environments or markets that demand a reduced embodied carbon footprint will have a higher value when recovered for reuse.” So, if recovered steel of a predictable structural grade has a lower embodied carbon, it will be preferred and valued more. Companies are being valued by their carbon footprint and ability to reduce carbon emissions, and embodied carbon is an easy way to do that.”

“Recycling is only good if the quality can be predicted”, Johnson adds. “Graded and separated steel is a known quality, while mixed scrap devalues into a lower market. Recovered steel from China has been found to have copper contamination,” he adds. “Contaminated steel is weaker and unsafe for construction, and so its value goes down, because its quality is not able to be predicted. So, it trades at a much lower value and can actually be dangerous on the open market if people sell it for something that it’s not, which is why quality is so important in this discussion.”

“If we change the way the products are selected, designed and used, they can be recovered and retain economic value. Then we don’t have a problem at the end of the pipe. But if we only focus on how we more efficiently receive the trash sent our way, we’re missing a big part of the loop and we have lost the economic value.”

Nordic Circles in Norway transforms ships and oil rigs into environmentally friendly building products. The start-up company acquired steel from this former ferry to build urban quays that also function as “fish hotels” bringing marine life back to city port. To upcycle the steel, pieces are cut out from the car deck and transported to regional steel production partners around Bergen. (Source: Nordic Circle, October 2021) https://www.nordiccircles.com/news/nordiccirclesattedx-eps2g-h763c-ft3yh

INNOVATING BUSINESS MODELS

Remanufacturing and Repair

‘Remanufacturing’ restores a used product to an as-new condition with original or improved performance and a warranty that matches a new product, as well as bringing benefits of extending a product’s life, reducing raw materials consumption and waste, and creating opportunities for skilled labour. Companies operate reverse supply chains that collect and return the used products for remanufacturing.

The regular repairs and maintenance needed in the course of a ship’s life and the large network of marine equipment manufacturers provide circular opportunities for remanufacturing of ship components from small-scale ship repair, planned dry-docking repair and maintenance opportunities to large ship overhauls and conversions.

Europe plays a leading role both among builders of complex vessels (including a growing number of cruise liners) and among original equipment manufacturers (OEMs) of marine equipment such as propulsion systems, cargo handling and electronics systems. A VTT Technical Research Centre of Finland study by Kim Jansson found that European leadership in complex vessels and OEM equipment creates opportunities for circularity in these domains.

Remanufacturing in the marine industry has room to grow at multiple scales, according to the VTT study. Replacing components through repairs or replacing spare parts, such as for heating, ventilation and air conditioning (HVAC) maintenance, can take place on board a ship. During scheduled drydocking, OEMs or companies contracted by them can collect diesel engine cores (cylinder covers, pistons, piston crowns, rods, exhaust valves) for remanufacturing or new purposes. For cruise ships, repair and refurbishments typically occur every 10-15 years, in which case a turnkey provider may engage in remanufacturing complete cabins to as-new condition, from reupholstery to floors and plumbing, etc.

Standardisation among products, innovation and a knowledgeable skill base are needed to bring remanufacturing into the circular transition, as well as overcoming uncertainties in the reverse supply chain and finding customers to reach a sufficient economy of scale, the VTT study finds.

Ship series, sister ships, big ships with similar components and partnerships with OEMs are all pluses for developing a circular remanufacturing business model for the maritime sector. The need to replace components in regular ship surveys and maintenance provides a basis for a transition to circular remanufacturing business model, which could be integrated into the development of ship recycling hubs.

Circular Ship Recycling Hubs

Denmark has one of the most active ship recycling industries in Europe, with activities in Esbjerg, Frederikshavn, Grenaa and Odense, as well as some 1 000 OEM marine manufacturers and suppliers. Several business models could support circular ship recycling clusters in Denmark based on remanufacturing of high-value equipment of complex ships, opportunistic breaking at shipbuilding yards, or recovering steel for recycling, according to an exploratory study published by Copenhagen Business School (CBS).

The CBS study found that ship recyclers in Denmark that recover high-end equipment from complex vessels can make a profit despite the higher labour and environmental costs associated with dismantling ships in the EU. Ship recycler Fornæs was reported as making a profit from reselling salvaged equipment, for example.

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LEVIATHAN

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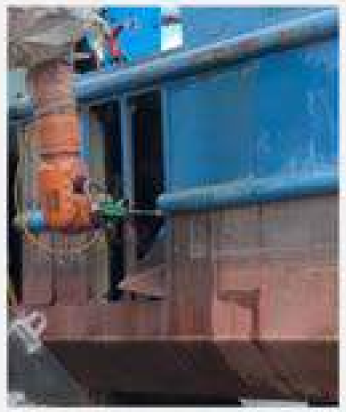

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We take ship recycling into the 21st century.

The same study found that many OEMs were already developing products for repurposing and had begun building capacity to absorb second-hand material streams. In an example of networking and collaboration to develop up- and downstream relationships between recyclers and parts manufacturers, Alfa Laval and Stena Recycling have set up the Re-Made to Matter programme, which refunds customers for worn plate heat exchangers which it reprocesses into new and improved ones.

The study also looked at a business model for recycling ships in shipbuilding yards. Fayard, for example, has repurposed its dry-dock facilities and contracts to HJ Hansen, which brings skills and equipment for ship dismantling. This model of breaking in shipbuilding yards requires speed and efficiency due to the high costs and scheduling of the dry dock.

Ship recyclers that have the capacity to handle large volumes of material were considered most apt to adopt a business model fully invested in steel recovery. However, achieving circularity for this purpose would also require new models for steel recycling and recovery in Denmark. According to the report, Danish ship recyclers currently export most scrapped steel to non-EU markets, while Danish steelworks NLMK DanSteel imports steel slabs from Russia and Ukraine for its high-quality products. In addition to this circularity gap, the report notes that the scrapped steel could command a higher price if there were more investment in sorting.

"There was a folklore-like view that shipyards building new vessels can't use recycled steel," says Knud Sinding, Associate Professor with the Faculty of Business and Social Sciences at the University of Southern Denmark, one of the CBS study's authors. "We never found a reference that proves that this is the case. There is nothing in the rules in the American Bureau of Shipping or whatever the insurers use in terms of standards that says anything about the origin of the steel, but rather about impurities or the chemical makeup of the steel. Impurities are an issue, and they are troublesome. It can come to a point where you can't use the steel without diluting it with new virgin material. An alternative is to simply sort the steel better. So, it comes back to these simple views."

Circular Ports

The city of Amsterdam recognises the important role that ports can play in the transition to a circular economy, and intends that Port of Amsterdam, a public company, and municipal waste company Afval Energie Bedrijf (AEB) will help the city to fulfil its goal to achieve full circularity by 2050. Besides being central to the municipal circular strategy, Port of Amsterdam has also partnered with DECOM Mission Blue, a newly formed network of companies created to decommission offshore installations and large maritime objects, including ships.

As the circular economy is expected to increase local business structures as companies form clusters to exchange materials and cycle used products, ports will need to consider how the transition will affect their business models. As an example, a research team with the Copenhagen Business School, Lee Kong Chian School of Business, and Port of Amsterdam predicts that cargo volumes in the Port of Amsterdam will diminish in the circular transition, and that port dues and land rents will overtake cargo fees as the port's larger share of revenue.

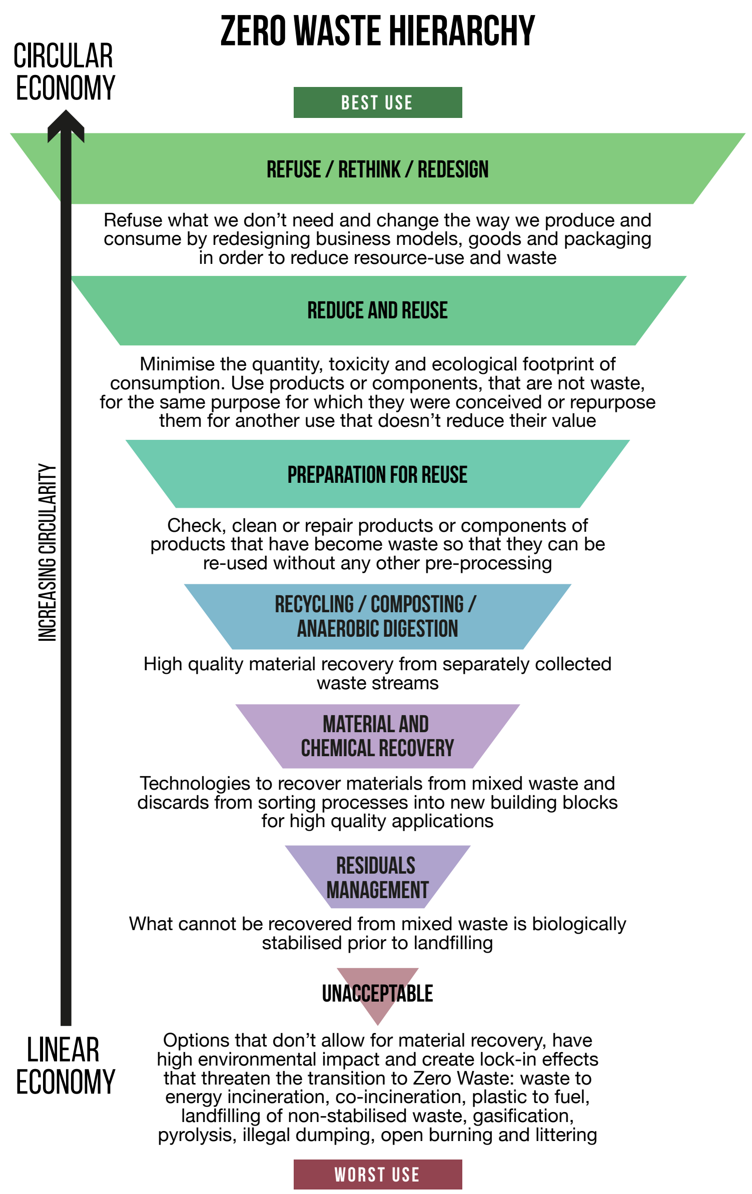
With its ambition to become the "most important circular economy hotspot in Europe", Port of Amsterdam has dedicated property for lease to circular and biobased companies, invested in its Prodock innovation hub to support start-up enterprises and development of new products and processes, and installed infrastructure such as a pipeline to transport fruit juice wastewater for biodiesel conversion and a multiuser, multi-cargo berth with cranes to be used by local recycling companies.

Scrap recycling companies currently export scrap overseas from the container terminal in Amsterdam, but with growing interest to lower the carbon footprint of steel by recycling scrap within Europe, and with the addition of ship recycler DECOM Amsterdam on the scene and recent partnership with the DecomMissionBlue initiative of Amsterdam Ijmuiden Offshore Ports, the stage is set for the Port of Amsterdam to a play more active role in developing new circular models for scrap steel and ship recycling.

CIRCULAR MATURITY

In a study of the circular maturity of Belgium's ports, Elvira Haezendonck and Karel Van den Berghe develop a scale of circular progression. Recycling activities to recover materials, frequent within the studied ports, represented an intermediate level of circular maturity. Energy recovery symbiosis, a common entry point for ports, represented the lowest level of circularity because the process consumes and loses materials. The authors determined that orchestrating new cargo streams, e.g., by bringing new supply chain relationships, types of cargo and reversed logistics into the circular transition, constituted the highest level of circular maturity and was the area needing greatest development. To achieve circularity, the authors say, ports need to develop their capacity to collaborate and connect actors, testing and development facilities, material flows to recover resources and extend product life, and a framework based on sustainable energy, transport and logistics, and reduced environmental costs.

The Belgian ports circular maturity research draws upon the results of Circular City Ports, a project organised by Circular Flanders, a public and private partnership hub for the Flemish circular economy. Circular City Ports presents the circular activities of actors within city ports in northwest Europe, including companies that operate within ports, such as Beelen Recycling in the North Sea Port, for reusing and recycling materials from building demolition with the goal of achieving circular demolitions, and TSR – The Metal Company in the Port of Hamburg, for combining scrap metal recycling and remanufacturing with recovered materials. The circular city ports project also mentions CityDepot, an urban distributor in the port of Brussels, for encouraging the city's economic actors to integrate reverse logistics in their operations, i.e., the process of returning used products to the manufacturer, typically for recycling or refurbishment. The city port of Dordrecht and its neighbouring towns are also highlighted for developing a training centre to establish connections for remanufacturing in the maritime sector. On a larger scale, Circular City Ports highlights Smart Delta Resources in North Sea Port (Netherlands and Belgium) and the surrounding region for bringing together large companies in the steel, chemical, energy and food sectors to reduce the use of valuable resources through industrial symbiosis and become CO_2 neutral by 2050.



© Adapted from Simon, J.M., Zero Waste Europe (2019). Edited to indicate increasing circularity within the hierarchy and indicate retirement of unacceptable materials.

ETHICAL AND SUSTAINABLE CIRCULARITY

Establishing Legitimacy

Critics warn that a circular transition that focuses on technical solutions and ignores social factors will lead to unsustainable outcomes by marginalising vulnerable groups or failing to curb the extraction of limited resources driven by the growing demand for goods. Terms such as a "sustainable", "ethical", or "just" circular economy are used as a reminder that the circular transition needs to stay on track with social values and sustainable development goals.

Legitimacy hangs on corporations and governments being honest and transparent about the sustainability of their circular activities. Companies can avoid greenwashing by being upfront about the shortcomings of their activities, saying not only what they will solve but also what they won't and by acknowledging the social and political conditions that will need to change if their activities are going to actually work sustainably.

Recycling on Steroids?

The potential for a disconnect between circularity and sustainability has been noted by Jim Puckett, Executive Director of the Basel Action Network (BAN), who calls for an "ethical circularity". Puckett tells the story of how at a ship recycling congress, representatives were presenting films on "how their operations were 'a vital part of the circular economy'. Yet these are the sites where the most exploitative, primitive 'recycling' still takes place... beaches are polluted, mangroves destroyed and impoverished workers have horrendous accidents or are exposed to toxic paints, lead, asbestos and PCBs." There are dangerous consequences when actors misunderstand, greenwash or co-opt the circular economy, Puckett says, adding that, without oversight, "the circular economy will become recycling on steroids, accomplished at any cost and at the expense of any population or ecosystem anywhere".

Innovating a Just Circular Economy

Patrick Schröder, in a report for the Chatham House policy institute, warns that developing countries risk being caught off guard by the circular economy, for example if industrial restructuring by developed countries disrupts secondary material flows to developing countries and inadvertently impacts workers. The transition to a circular economy will challenge developing countries in similar ways as the transition to a carbon neutral economy and will require comparable response mechanisms, according to Schröder. Climate-related financial mechanisms, such as the EU Just Transition Fund to help carbon-dependent and poorer regions diversify their economy and reskill workers, can serve as prototypes of mechanisms to help developing countries transition to a circular economy.

Meanwhile, stakeholders need also to be involved in participatory processes to determine the roadmap for their community's economic future, Schröder says. Countries prepared to provide repurposing, repair and refurbishing services or to create environmentally friendly products from recycled materials will be in a better position to adapt to the circular transition. One case study in the Chatham House report, for example, describes how social entrepreneurs could repurpose scrap yarn and garment pieces from Bangladesh's textile industry into 1 billion new garments annually. Novel opportunities could include metal-leasing models supported by digital passports that would allow producing countries to maintain ownership of extracted resources throughout the value chain and product life.

The Chatham House report gives room for thought when considering steel and ship recycling in light of disruption and innovation.

As it transits to a circular economy, the EU is considering policies to restrict exports of scrap metal to countries with lower recycling and environmental standards while boosting the recycling of its own steel scrap at home. The list of EU-approved ship recycling facilities and Basel Ban amendment could also redirect end-of-life ships towards different facilities that guarantee higher environmental and safety standards. The disruptions that would be felt by current ship recycling countries could be opportunities to provide decent and safe work through innovation and participation backed by adequate financial mechanisms, as the Chatham House report describes in broader terms.

China, like the EU, has embraced a circular economy transition, and the country's ban on plastic waste imports from 2017 is a dramatic example of the potential for the circular economy to disrupt trade in global scrap and recycling markets. The abrupt ban by China, then the world's largest importer of plastic waste, caused the global flow of plastic waste to plummet by 45.5%, diverted exports to low-income countries, confronted developed countries with their reliance on exporting waste to poor countries and provided an incentive to reduce plastic packaging (Wen, Z., Xie, Y., Chen, M. et al., 2021). China also banned foreign imports of ships for recycling in 2018, closing options for ship recycling at some of the world's higher standard ship recycling facilities.

© Jonathan Kirn / Alamy Stock Photo

With the aim of developing a framework that will bring social and ethical dimensions into the circular economy, the Just2Ce (pronounced "Just to See") EU Horizon 2020 project collaborates with research teams in Europe and Africa to assess practices and policies for responsible circular activities in different geographical and cultural contexts, asking: "Whose voices are heard? Who will be ignored? Who will pay the costs and who will benefit?"

Just2Ce case studies include a participatory civil society plan to guide an economic and social transition from steel manufacturing in the city of Tranto, Italy; an innovation technology cluster at a former steelmaking and coal centre in Sheffield, UK; the involvement of informal waste-pickers in improving electronic waste recycling efficiencies in Ghana; and "prosumer" cooperatives where individuals are both producers and consumers, in the Alentejo region of Portugal.

The discourse on circularity needs to broaden its focus beyond technical fixes," says Mario Pansera, Director and European Research Council (ERC) Grantee at University of Vigo Post-Growth Innovation Lab. "The circular economy doesn't question unfair social relationships. Because at the end of the day, we are already in a circular situation in the sense that we extract precious metals and resources from the global south and process them in other countries and then mostly consume them in the global north, which at the end of the process returns to the global south.

"Degrowth is a planned reduction in the use of energy and resources aimed at restoring the balance between the economy and the living world, in order to reduce inequalities and improve human well-being."
Jason Hickel, economic anthropologist

"In addition, the circular economy doesn't question the imperative of economic growth. Even if we can maximise circularity and maximise the materials we reuse, recycle and so on, it is not going to be enough if we judge the economic success of our system or society with this idea that economic growth, or GDP, must increase forever," Pansera continues.

Replacing gross domestic product (GDP) as a measure of national and global economic health with a new set of indicators is one solution, says Pansera, but even more fundamentally, he cautions, "We won't be able to keep the growth rates in the next 20 years… It means we have to decide if we want a chaotic collapse or we want an orderly downscaling of electricity consumption, plastic production and the number of ships moving goods around the world. And how we do this downscaling is the problem, even more important than changing indicators."

"The fundamental problem, before we get into how we can recycle the steel or how we can keep the value, is why we need the steel in the first place and who decides? For me, it's a political question. Before getting into a discussion of how we recycle the steel, we should start from how much steel we need and for what reason."

MOPPING UP AND BUILDING MORE

Reducing consumption of electronics and fast fashion is a familiar concept, but what about consumption of ships? During economic downturns, freight rates dive and there is an uptick of ship owners selling idle but otherwise operational ships for scrap, and a cycle of ship building and scrapping emerges. Dr. Elizabeth A. Sibilia, a Postdoctoral Fellow for the ERC funded PORTS project at the University of Oslo, has studied the underlying dynamics of the making of the global ship scrapping market. Her research demystifies the oft-told story of supply and demand as the reason for the expansion and contraction of the global ship scrapping market, arguing that easier access to credit offered by financiers and bankers to shipowners since the 1960s has underpinned a new scale of speculation related to shipbuilding. Financialisation helped condition a more precarious shipping sector in the decades that followed as evidenced by the premature scrapping of ships during periods of economic downturn and the subsequent, and vital, expansion of ship scrapping markets allowing for the continued flow of capital through the shipping economy. It is, after all, the scrapping markets that are able to 'mop up' all of these devalued assets, enabling more debt-financed ships to come online in the future.

A TRUE AND ETHICAL CIRCULAR ECONOMY

BY JIM PUCKETT

For almost a decade now, we have become quite accustomed to hearing the term and concept 'Circular Economy' and of the need to wean ourselves away from the linear model of 'take, make and dispose'. This trajectory sounds good, but is it revolutionary? When I first heard the term circular economy, having worked for very many years in the arena of waste management and having witnessed many ideas and turns of phrase come and go, I wondered – what is different here?

We have heard of… *industrial ecology, cradle-to-cradle, close the loop, clean production, waste minimisation and prevention, reduce, reuse, recycle, profit from pollution prevention, waste is food, zero waste, green chemistry, systems thinking, the waste management hierarchy, the natural step, biomimicry, regenerative design, life-cycle thinking*… and now the dominant term is circular economy.

After absorbing the literature to date, I have concluded that the circular economy is meant to accommodate all of the above as it borrows liberally from much of the last two decades' best thinking. But at the same time, and what is too often forgotten, is that it originally and uniquely borrowed from the field of ecological economics as well, and that discipline's concept of accounting for and hopefully eliminating "negative externalities", – ways to make others, or nature, pay for your damage, while also accounting for and hopefully preserving "natural capital" and "ecosystem services" – nature's benefits to humans put in economic terms.

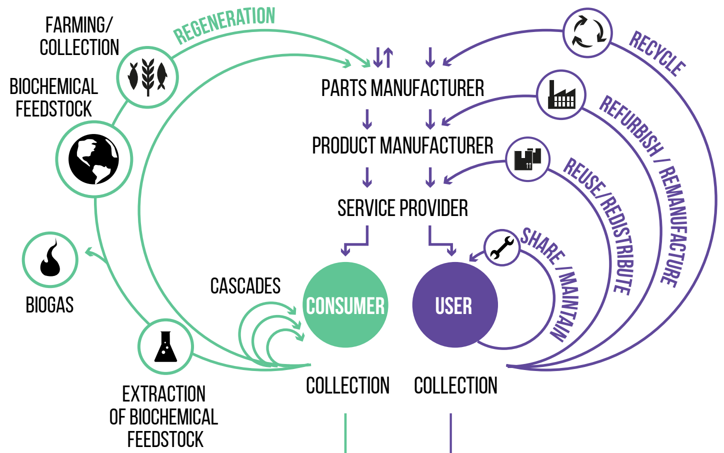
Today, however, the narratives surrounding a circular economy fail to emphasise these crucial social and ecological economic valuations and over-emphasise the techno-cratic and engineering pipelines – the looping arrows of returning material flows. In short, they are over-emphasising the "Circle" and under-emphasising real world "Economics".

If one takes a quick look at the once famous infographic of the circular economy published by the MacArthur Foundation, we can see that it in fact meant to introduce three key principles, but sadly in common usage all but the middle one with the exciting graphics are largely forgotten today.

OUTLINE OF A CIRCULAR ECONOMY

PRINCIPLE
1 Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows
ReSOLVE levers: regenerate, virtualise, exhange

PRINCIPLE
2 Optimise resource yields by circulating products, components and materials in use at the highest utility at all times in both technical and biological cycles
ReSOLVE levers: regenerate, share, optimise, loop



PRINCIPLE
3 Reveal and design out negative externalities

MINIMISE SYSTEMATIC LEAKAGE AND NEGATIVE EXTERNALITIES

PRINCIPLE
4 Fostering Cycling and Recycling

This principle which is today conflated as being the entirety of a circular economy is the one principle which can only truly exist if the other three are in full force.

© Pucket, J., adapted from Ellen MacArthur Foundation.

The first and third rows depicted have been all but forgotten by the many proponents and practitioners of a circular economy today. Yet, these ecological economics principles are the prerequisites to preventing linearity. Given our current situation where such externalities and system leakage are the rule and the resultant pollution regularly incurs losses of trillions of dollars' worth of natural capital and human health costs per annum, these principles are foundational. What is a mangrove forest worth? What is a clean beach worth? What is breathable air worth? What is a non-toxic workplace worth?

The well-known middle section of the diagram with the arcs and arrows returning materials back into maximal reuse is well understood but even it is incomplete as it lacks a major emphasis on design for waste prevention and circularity (more later). Moreover, the goal of circularity will be impossible to achieve if we don't comprehend that those arcs and arrows lose all meaning as they wind their way across an uneven global playing field pocked with accepted negative externalities and tilted on a steep gradient flushing wastes and toxic jobs to the Global South. In such a landscape of inequity, the intended circular pathways suddenly become very straight, on a brute course of least economic resistance, exploiting labourers, communities and environments of low-wage countries along the way.

The current means by which materials are extracted from the earth, processed into products, and managed as waste has historically been a saga of negative externalities. This is a narrative far better told by cost-benefit analyses, photographs of damage, medical exams, interviews with victims, and chemical analyses of air, water, and soil than by theoretical circles and arrows on a poster. It is a story of a "circle of poison" rather than anything we should hail as visionary. It is not in fact a true, nor ethical circular economy. It goes like this:

Beaching in Bangladesh 2022 - © NGO Shipbreaking Platform

Chapter one, we witness devastating extraction of resources from the Global South. And then these resources are turned into products in toxic workplaces by cheap labour, in highly-pol- luting factories. Chapter two, the products are exported to the Global North where they are enjoyed with few externalities that might harm the user. Chapter three, at end-of-life the obsolete or waste products are exported back to the Global South for highly-polluting and often only partial recycling.

In this way, the South is disproportionately burdened by the designed and accepted negative externalities of our products' life cycles.

Like the many terms we used before "circular economy", the lexicon does well within the world of technological, physical, and biological theorising. Where it falls down is when it must own up to the decisive drivers of brute economics, which encourage exploitation via institutionalised negative externalities made readily available by the injustices of globalisation in the context of stark global inequity.

It is with all the above concerns in mind that we would propose a new name for that which we aspire to realise. We need to begin speaking of a True and Ethical Circular Economy, complete with a new infographic with a reformulated set of pillars.

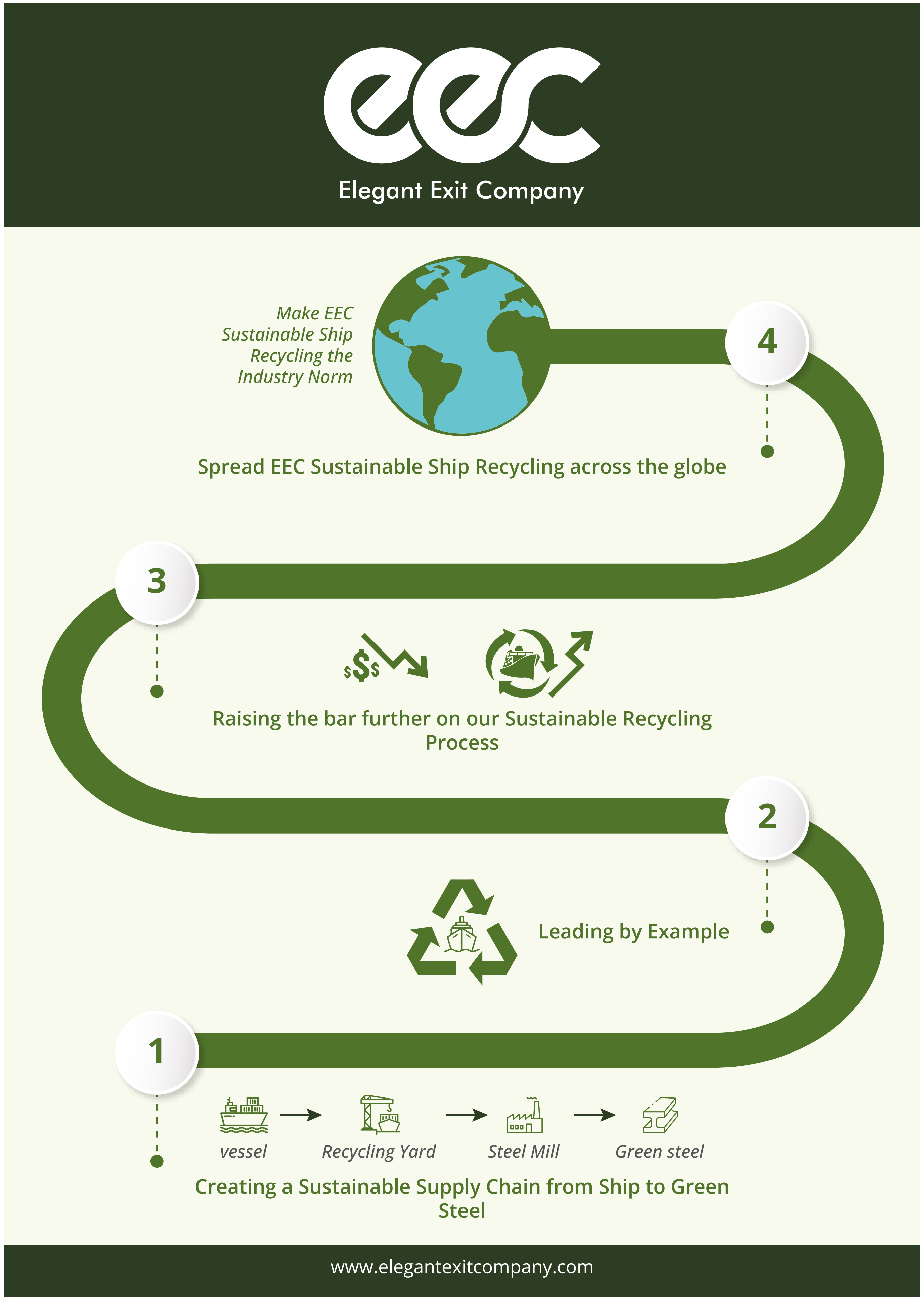
The new poster we would wish for will first place a new foundational Principle at the top to represent the prerequisite of Design for Waste Prevention. Recycling and even circularity itself is never as important as turning off the tap of wastes that are flooding from our societal bathtub from unnecessary or ill-conceived production and consumption. At the very inception, even before actual production, particularly for those products and services which create waste streams that are hazardous, out-of-control, or difficult to manage, we must ask, do we need to produce a product or a service? Do we really need this thing? Does the product fulfil a societal need, and if so, does it do it in the most efficient and least impactful way? Before life-cycle analysis, we must engage in a needs analysis and product/service impact assessment. Can the function be fulfilled in a better way? If we decide the product does need to be produced, then, how can we maximise its longevity, and when it does reach end-of-life, can we design it to maximise ease of upgrading, repurposing, or finally, recycling? It is far too rare to hear proponents of a circular economy speak of simply not designing products that are harmful or not inherently circular in nature. Too often the discussion begins after the product has been produced.

Second, old principle three will be made the new number two, Eliminate Negative Externalities. This in our view is the often forgotten but vital prerequisite of any true and circular economy. As described at length above, we must internalise the very real and all too convenient hidden costs of our activities. At the outset, we must recognise that the global inequity that currently exists in our social structure creates an uneven playing field that allows for easy exploitation via cost externalisation. Any true circularity depends on recognising and then mitigating, perhaps through regulation, the cheap and dirty pathways which leverage economic disadvantage to exploit the less powerful, the global commons, or future generations.

Third, we would place the next prerequisite priority, that of Preserving Natural Capital, firmly in the True and Ethical Circular Economy firmament. We must recognise and value natural services and wealth as this indeed is what we all rely upon for our very survival, both physical and spiritual. This includes not only wilderness, flora and fauna, but also all the natural systems of our entire ecosphere, including our climate, air, water, and the food we can produce with such natural systems. Losing natural capital is most often irreversible and a loss for which we will pay the most dearly, including the ultimate loss of our planetary home, all or in part. Yet Natural Capital is the first to be sacrificed when negative externalities or ill-conceived design is allowed to persist.

Finally, and only after we have paid the utmost attention to the first three requisite concerns, can we highlight Fostering Cycling and Recycling as the fourth principle. Ironically, this principle which is today conflated as being the entirety of a circular economy is the one principle which can only truly exist if the other three are in full force.

Indeed, a True and Ethical Circular Economy can only exist when we rethink our design methodology – our entry points into production, mapping out the planetary return on investment over the long term for all peoples and species. It can only exist if we remove the systemic cost externalisation based on global inequity and the ease of its exploitation. It can only exist if we preserve our living earth and its intricate systems. Only when you have done these things can you begin to dream of true circularity.


Elegant Exit Company
Make EEC Sustainable Ship Recycling the Industry Norm
4
Spread EEC Sustainable Ship Recycling across the globe
3
Raising the bar further on our Sustainable Recycling Process
2
Leading by Example
1
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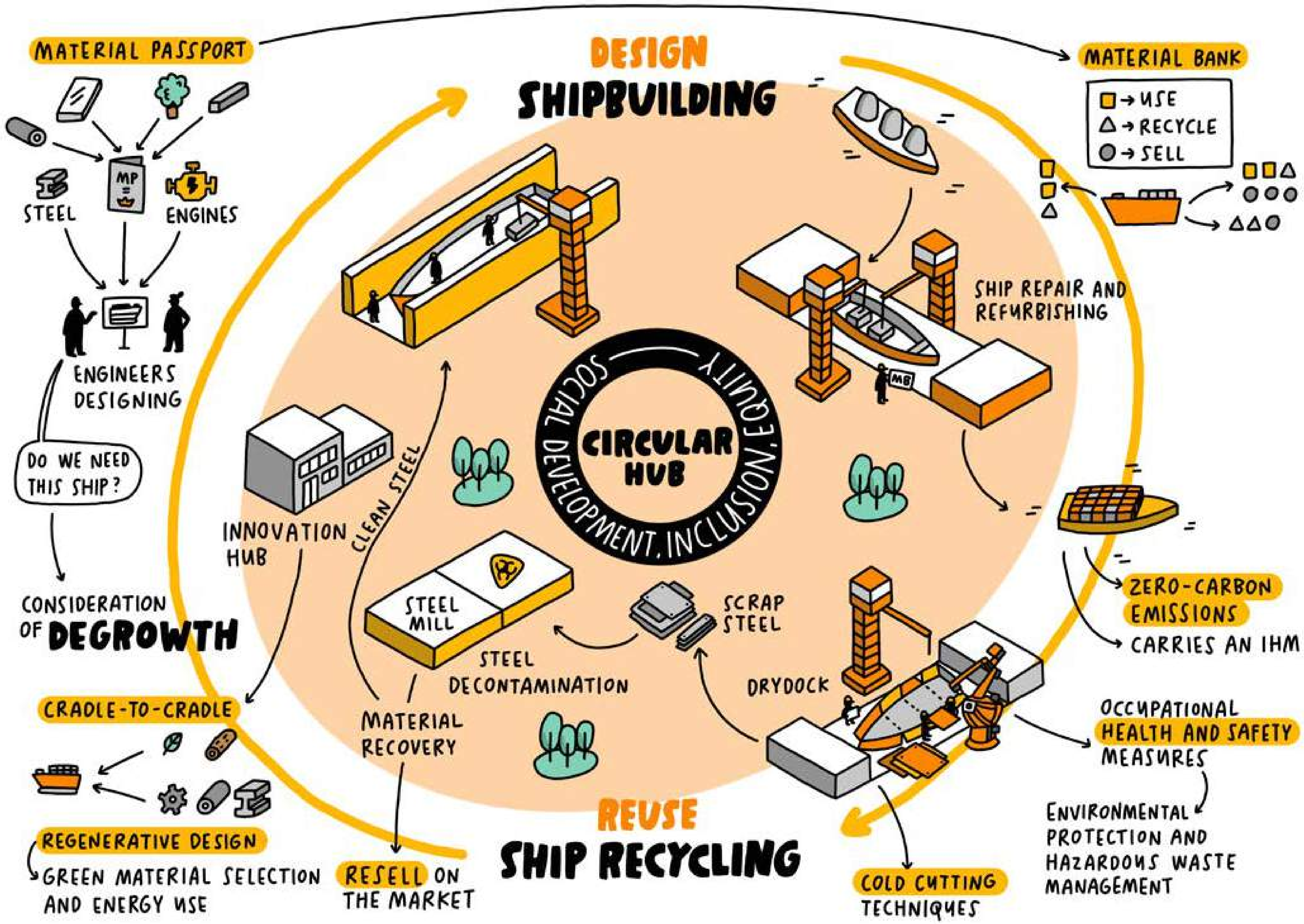
MATERIAL PASSPORT
MP
STEEL
ENGINES
ENGINEERS DESIGNING
DO WE NEED THIS SHIP?
CONSIDERATION OF DEGROWTH
CRADLE-TO-CRADLE
REGENERATIVE DESIGN
GREEN MATERIAL SELECTION AND ENERGY USE
RESELL ON THE MARKET
DESIGN
SHIPBUILDING
MATERIAL BANK
→ USE
→ RECYCLE
→ SELL
SHIP REPAIR AND REFURBISHING
MB
SOCIAL DEVELOPMENT, INCLUSION, EQUITY
CIRCULAR HUB
INNOVATION HUB
CLEAN STEEL
STEEL MILL
STEEL DECONTAMINATION
SCRAP STEEL
MATERIAL RECOVERY
DRYDOCK
ZERO-CARBON EMISSIONS
CARRIES AN IHM
OCCUPATIONAL HEALTH AND SAFETY MEASURES
ENVIRONMENTAL PROTECTION AND HAZARDOUS WASTE MANAGEMENT
REUSE
SHIP RECYCLING
COLD CUTTING TECHNIQUES

THE TECHNOLOGIES UNLOCKING THE FUTURE OF SHIP RECYCLING

BY DANIELA DE LORENZO

New techniques and technologies for cutting, cleaning and coatings are a sign of dynamism in the ship recycling sector. From Finnish robotic labs to new drydock facilities in South Africa, innovative technologies and new approaches to ship recycling are showing how the industry can reduce environmental hazards and improve worker safety.

Digitalisation is an increasingly important driver for efficiency and cost-effectiveness and the movers and shakers of the ship recycling business are getting on board with it. New technologies promise to close the competitiveness gap with substandard ship recycling as automation improves the quality and speed of operations, the ease and safety of executing specific tasks and the ability to respond to one of the biggest challenges facing the maritime industry.

If recent scrapping patterns persist, by the end of 2030 approximately 43% of the existing global container fleet will be scrapped, and the demand for dismantling will exceed over 1 500 ships annually.

Moving towards fully circular processes will boost the recycling business and make sustainable ship recycling more economically viable.

Cutting through the emissions

The traditional way to dismantle a ship is to use torch cutting, a practice that dates from 1903. Torch cutting is a manual machine-based technique that uses heat to cut through vessels' bulkheads. Modern technologies can remove the downsides of this slow process, which also releases hazardous gases from the heating of ship paints, and increases greenhouse gas emissions levels.

Cutting techniques that avoid heating offer the best means to minimise risk. Water jet cutting releases water mixed with natural abrasive substances such as sand through a small diameter nozzle. This method can be used for a variety of metals including steel and is currently the most promising technology for this task.

The environmental benefits of water jet cutting are paired with cost-efficiency and maximisation of material recycling. The highly defined kerf, or cut, produced by the fast high-pressure water jet saves raw materials, energy, and time, as workers only need to pass over the same piece once. Unlike traditional cutting systems, the machinery requires no cooling or lubricating

The robot, nicknamed "Employee of the Month" by founders Karsten and Simeon, carries the cutting nozzle to cut the shell and frames of the ship into smaller pieces. Together with their cold cutting technology, it is the main core of how they define modern ship recycling. No hot works, no preparation beforehand and no employees being put at risk on board the vessels. © Leviathan GmbH oils, reducing the need to buy, maintain and dispose of chemicals. The most innovative waterjet machinery can be configured with a closed-loop system in which water is continuously reused and the power needed can be calculated, increasing the potential for energy savings.

Companies such as Wika and Hammelmann (both Germany), Microstep (Slovakia), Muotorerä (Finland) and Thibault (France) have produced and supplied water jet technology to numerous industries, including within the maritime sector.

On a larger scale, the Laboratory of Intelligent Machines at LUT University (Finland) is working to develop a portfolio of machinery tailored to ship recycling based on robotics and mechatronics, a combination of mechanical, electronic and electrical engineering systems that can generate simpler, more economical and reliable systems. The latest technologies also enable the remote control of mobile robots, thus increasing work safety and precision. The Intelligence Machinery Lab hopes to be able to test and use its prototypes in Raahe, a port in Finland.

German ship recycling company Leviathan, meanwhile, has developed a new ship recycling concept founded on heavy robotics and water cutting technologies powered by clean electricity, which enable automated and emission-free scrapping at industrial capacity (read the interview on pg.32). By cutting ships into equal parts in a closed environment with a drainage system to purify used water, ships do not have to be pre-cleaned, allowing shipowners to deliver vessels directly. “We won’t have people inside fuel tanks doing the dirty work,” says co-founder Karsten Schumacher. Thanks to automation of the process, fewer workers are required and employees perform more supervisory tasks than dangerous manual work such as near-net cutting or hand finishing.

Going even further, Dutch company Aseco Europe has just developed its Circular Maritime Technologies (CMT) yard, which promises to require no workforce onboard a ship to be dismantled. The yard would use wires to slice the vessels into blocks the size of an office, at which point each would be processed in an automated system to be stripped, cleaned and crushed. The highly efficient model promises to cut and dismantle the largest ships in just six days: “Automatisation and low workforce are the two main factors that lower costs and turn our model into a viable business case allowing us to pay ships the same price as in South Asia, else shipowners will not turn their ship to us,” said Frank Geerdink, Managing Director at Aseco Europe. In just one CMT yard they would be able to handle 60 large ships per year, with only 55 people on a shift, he said

Beyond traditional waste management for material and waste recovery

Steel, which constitutes over 95% of a vessel structure, can be endlessly recycled. However hazardous materials such as asbestos, naturally occurring radioactive material (NORM) and mercury found in a ship’s structure need to be removed to obtain good quality scrap steel and the safe reuse of the raw material.

Hamburg-based NautilusLog is one of many startups that provide digitised solutions to map hazardous materials on a ship with little involvement of its crew or owners.

Sea2Cradle, a ship recycling consultancy firm, offers this service to shipowners.“Most shipowners do not invest in having their own people focus on ship recycling as it is not an activity they do on a continuous basis. That is also a reason why we exist,” says Bert van Grieken, Sea2Cradle’s commercial director. In the past five years, Sea2Cradle has performed over 250 inventories of hazardous materials (IHM) for shipowners obliged to comply with new regulations requiring them to have an overview of toxic substances in the ship’s structure, their location and approximate quantities. “There are still a lot of companies who couldn’t care less (about responsible ship recycling). But the amount of people that do give this a proper thought is increasing. There’s a lot of pressure on companies to do things correctly in terms of environmental, social, and governance criteria,” van Grieken continues.

A large portion of the environmental and health hazards associated with ship recycling comes from copper and chromium-6, compounds present in paints and coating formulations applied to the external layers of the ship. Torch cutting causes air pollution and releases contaminated steel particles that can affect marine life due to

© Purified Metal Company

© Kishorn Port

the anti-fouling coating. Carrying out sustainable coat-stripping prior to cutting could reduce emissions of hazardous pollutants. Dry ice blasting, which is recognised as the most effective technique for this, uses dry ice pellets to replace chemical cleaning solvents in a procedure that emits neither CO_2 nor toxic fumes. Companies such as FerroECOBlast (Slovenia), and Arctic Fox (UK) are specialists in producing machinery for this process.

Other companies have focused on how to collect and remove mercury. Nomura Kohsan (Japan) roasts the substance to a temperature between 600°C and 800°C that vaporises the hazardous compound. Econ Industries (Germany) uses a vacuum distillation technology that enables mercury to be mixed and heated under controlled vacuum so it is isolated from the rest of the waste.

However, as cleaning procedures are costly, Purified Material Company (PMC) (Netherlands) has created a steel scrap recycling system able to generate new raw material without the scrap needing to be pre-cleaned (read the interview on pg.34). In its first waste management plant, PMC treats contaminated steel by collecting, filtering and neutralising the toxic fumes produced in the melting of steel, which cannot be carried out in a traditional steel mill facility. “I think that the shipowners have the responsibility to see that their ship is being demolished safely and that the waste coming from the ship is being handled in a proper way,” says Nathalie van der Poel, co-founder at PMC. “My factory can provide solutions and transparency in the supply chain”.

Of course, many other materials are found on vessels and need solutions to process and recover them, too. Belgian metals recycling firm Galloo, for example, applies a post shredder technology to transform rubbers and foams using thermal valorisation. This enhances their value as plastics and gives them a second life.

End-of-life ships and a new life for drydocks

Shipbuilders and port authorities are also on the hunt for technologies to accelerate the shift to efficient and cost-effective shipyards. Providing facilities and services for ship recycling could be an attractive solution to drive revenue and business innovation. Across Asia, the Middle East and Europe there are several empty dry docks linked to existing industrial port and maritime infrastructure to which ships could return at their end-of-life stage.

© Elegant Exit Company

Dutch ship recycling firm Elegant Exit Company (EEC) works to create a future model of port areas in which drydocks are upgraded in such a way that they can dismantle vessels in series of three, creating a full production line (read the interview on pg.33). This model could provide an additional revenue stream for port entities and shipyards, which could let unused areas on a long-term basis to ship recycling companies. Recycling facilities could benefit local economies by creating jobs for workers skilled in handling complex technologies to dismantle commercial marine assets.

British company Atlas Decommissioning has recovered the dry dock in Inchgreen, Scotland, where heavy-lifting gear could be used for ship recycling: "The conversation that we need to have with shipowners is to ensure that they follow through on their promises to responsibly decommission their maritime assets," said Michael Dixon, managing director. "They need to choose the right method and not look at an increased profit margin versus a responsible decommissioning solution." The company signed a long-term lease in 2021 for the dry dock, where they aim to recycle up to 500 000 tonnes, the equivalent of 12 vessels per year. Atlas Decom is now awaiting approval for European Union ship recycling having obtained the approval necessary from the United Kingdom.

With more companies and ports now aware of the potential for future recycling scenarios and the obligation for shipping companies to recycle sustainably, they are adapting and innovating to support recycling operations more sustainably. In May 2022, the European Union approved three more yards on its list of sustainable ship recycling facilities, among them Scotland's Kishorn Port. After a multi-million pound investment to extend its dry-dock facilities, the port can now receive vessels up to 250 metres long, building on its sustainable decommissioning expertise with floating offshore wind assets.

South Africa is also seizing the opportunity to develop an environmentally-friendly ship-recycling facility, in a dry dock on its west coast. The location of the 34South facility in the Saldanha Bay Industrial Development Zone would relieve shipowners of the cost of sailing through the Suez Canal while sparing fuel and operations costs for the further 12 000 km journey to reach scrapping yards in South Asia. 34South aims to employ a ship lift, a machine for transporting boats between water at two different elevations, to raise the vessels to be scrapped out of the water. As the technology is able to handle more than one vessel simultaneously, the system could foster scalability on the operational side.

Eco-innovation for the future of vessels

As maritime transport is now responsible for about 2.5% of global greenhouse gas (GHG) emissions, redesigning ships' tanks and vessel structure and integrating sustainable manufacturing processes are a priority for the industry. The shift towards using greener fuels or batteries drives down steel content on vessels in favour of lighter materials that improve performance and reduce fuel costs, maintenance needs and environmental impact.

Naval architects are experimenting with materials immune to corrosion and that will have a lesser impact on marine ecosystems. Aluminium, carbon fibre and graphene are currently leading the field due to their ability to make metals and plastic composites stronger and lighter.

Some Horizon 2020-funded projects, including FIBRESHIP, have looked into the environmental and cost benefits of utilising these materials for ship structures. They estimated that European shipping companies could reduce costs by up to EUR 1 billion a year by adopting their fibre-reinforced polymers for shipbuilding. The Ramsess project also advanced research on lightweight materials for the maritime sector and new manufacturing processes such as using resin infusion to build vessels with fully composite materials.

More focus is needed on components, too. Toxic anti-fouling paints and their associated hazards could be eliminated if shipowners shifted towards using certified eco-responsible coatings, paints and resins. In the long run, applying these products would be cost-effective as it would reduce the expense of removing, treating and disposing of dangerous paints. More environmentally friendly alternatives are already available as the chemical industry has invested in new, compound-free paints: non-polluting solvent-free coatings have already been used on Samsung Heavy Industries' liquefied natural gas carriers and Hyundai Heavy Industries' water ballast tanks. The latest revolution in antifouling paint comes from the Danish biotech company Cysbio - a spin-off from healthcare company Novo Nordisk's established Foundation Center for Biosustainability, which is rethinking the composition by adding eelgrass acid, extracted through fermentation technology. The biobased antifoulant could replace copper and other harmful chemicals, improving efficiency and the overall environmental impact of the ship on marine ecosystems throughout its operational life and at end-of-life.

BENEFITS OF NEW TECHNOLOGIES FOR RESPONSIBLE SHIP RECYCLING

- Accident risk reduction
- Automatisation to limit dangerous tasks
- Workers avoid contact with poisonous substances
- Green jobs
- Higher skilled workforce
- Reduced CO_2 emissions
- Fewer oily residues are released within marine and terrestrial ecosystems
- Waste management
- Avoidance of hazardous material to enter the environment or remaining within raw material to be reused
- Recycled steel to diminish production and emission of virgin new material
- New eco-materials production
- Fewer chemicals impacting marine ecosystems
- Less noisy materials that disturb marine life
- More efficient operations
- Less energy used
- Potential to use renewable energy for the recycling operation
- Less workforce needed

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LEVIATHAN

THE 'NO-BRAINER' SHIP RECYCLING OPTION FOR SHIPOWNERS

SIMOEN HIERTZ & KARSTEN SCHUMACKER

BY DANIELA DE LORENZO

Simeon Hiertz and Karsten Schumacher have celebrated an important first step in their goal to make **Leviathan** the first emission-free ship recycling company by acquiring their first two ships. Now they want to make it the norm.

Leviathan was set up in 2019, after founders Simeon Hiertz and Karsten Schumacher, based in northern Germany, had spent a decade working on how to modernise the shipbreaking process to operate at an industrialised capacity by incorporating the latest technologies.

The duo looked into high-water-pressure cutting technologies that are already used to decommission nuclear power plants and offshore assets: “We then combined this technology with robotics to adapt it to the ship recycling sector,” says Schumacher. The highly automated machinery and its cutting nozzle are controlled by engineered robotics to make precise kerfs, or cuts, to the vessels’ walls, without the need for workers to be in close contact with the ship. The machinery is powered by electricity from renewable energy, thus slashing CO_2 emissions to zero.

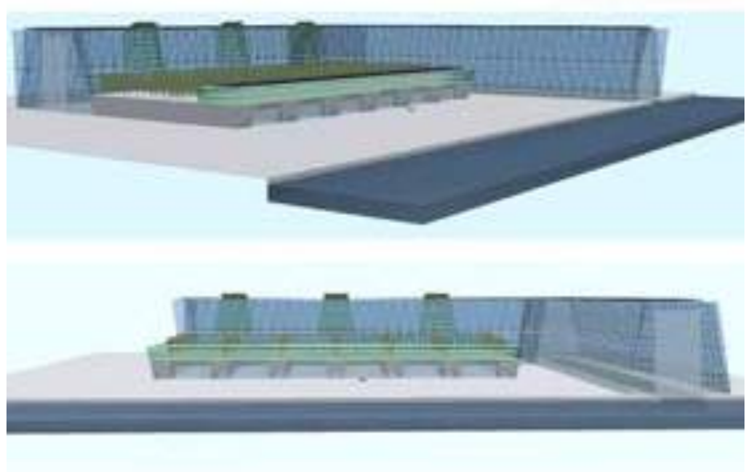
What makes their system a true dealmaker is that its water and waste handling procedure can sidestep pre-cleaning works.

When the ship’s blocks are dismantled into smaller pieces, they are cleaned in an automated system using pressurised water that separates clean steel from waste, including fibres, oil and sludge.

Schumacher guarantees that ‘dirty works’, for which ship recycling has a bad reputation, are obsolete: “We will need almost no workers to go onboard to prepare the vessel, and no fuel tank cleaning before cutting the vessel,” he says. On top of this, Leviathan handles all the waste and scrap within its shipyard premises and delivers the cleaned steel to adjacent steel mills.

According to Leviathan, the method is a no-brainer option for shipowners, as they need to do less to prepare the ship. Fewer operations and a smaller workforce guarantee Leviathan cost-efficiency, while the use of renewable energy complies with the EU’s goal to decrease emissions in heavy industry.

Stakeholders have started to invest in Leviathan, which when running at full speed can recycle 20 vessels per year: “Whilst our main market is likely to be the European fleet below 140 metres, of which we found over 1000 assets in the IMO database likely soon to reach their end-of-life, we are also targeting Panamax [medium-size] vessels,” added Schumacher. The biggest challenge, however, remains political: “In Germany, the government is waking up and seeing that there is a business case. But as we are trying to do something completely new, national authorities don’t know what scheme to follow and they might not be familiar with European regulations, so the bureaucratic side is slowing down our plans,” says Hiertz. This summer, Leviathan successfully started recycling their first two vessels in the drydock facility.



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EEC

PROCESS INNOVATION: BREAKING SHIPS IN SERIES

REIN AMELS

BY DANIELA DE LORENZO

By buying end-of-life ships and dismantling them in series, **Elegant Exit Company** aims to make shipbreaking more sustainable, efficient and profitable. We spoke with co-founder and director Rein Amels to hear more about its operational model.

Most shipowners tend to postpone the decision to scrap a vessel until the last minute and discard assets one at a time when the price of scrap steel is most favourable.

Dutch venture Elegant Exit Company (EEC) proposes a different model, to give a structure to the maritime industry which soon will need to scrap a major part of its fleet. Founded in 2020, EEC aims to recycle 750 000 tons of scrap steel from ships by applying a ship recycling disassembly line, making the process more cost-effective by reducing time, space and the number of operations. It is now fully operational with at least one facility to the east and one to the west of the Suez Canal.

The ‘recycling in series’ model operates in what EEC calls a ‘recycling dock system’ - a dedicated port area where quay walls surround a pool of water, ending with a concrete slip: “This will ensure that liquids won’t be dispersed in the environment,” says Amels. It will be possible to work simultaneously on three ships at three different phases of the recycling process: “We will have one at the cleaning berth; one floating, where we remove big blocks of steel, and one on the slipway where we cut the bottom part of the ship,” explains Amels. Four cranes will surround the ships, enabling the vessels to be dismantled from both sides, so more quickly. “The EEC model requires an extensive order portfolio to work sustainably, effectively, efficiently and fast. We also need extensive documentation about the vessels to know where best to cut and how,” says Amels. “As a process innovator, EEC has introduced its Slot Booking System and its Own, Operate and Recycle System to achieve the necessary order portfolio. EEC invites all First Moving Shipowners to cooperate with EEC on this innovative approach.”

© Elegant Exit company

EEC seeks to locate recycling dock systems close to steel mills, to make it more sustainable and cost-effective: “If you look at the value chain from ship to green steel, that's where we can play an important role. Shipbuilding steel is the best quality steel that mills can receive, it should also be ‘clean’, certified to have not harmed people and the environment”, concludes Amels.

PMC

NATHALIE VAN DE POEL

GIVING A SECOND LIFE TO CONTAMINATED STEEL

BY DANIELA DE LORENZO

In the Netherlands alone, around 80 000 tonnes of contaminated steel scrap disappears into landfill each year. **Purified Metal Company** is the first company in the world to responsibly process this hazardous waste and turn it into a high-quality raw material. We spoke with Nathalie van de Poel, one of its founders, about its technology and why the maritime industry should look into it.

Purified Metal Company B.V (PMC) invented a unique and circular process to remove asbestos, mercury, and Chromium 6 from contaminated materials, partly based on techniques already used in industry. "The combination of the different techniques makes it possible to destroy or neutralise all substances of very high concern (SVHC). Before PMC, steel could not always be cleaned and freed of asbestos. That's why it would end up in landfill," van de Poel explains, adding that scaling up such a process could increase the amount of green scrap steel available.

At PMC, the contaminated steel is melted at 1 500 °C, which destroys asbestos and separates other SVHCs from the steel. "Our plant in Farmsum (Netherlands) is totally different from any regular waste management factory, starting from its flue gas exhaust system," says van de Poel. During furnace charging and steel melting, the smoke and dust released would normally produce toxic emissions. "In our advanced exhaust system the flue gases are captured, filtered and neutralised," explains van de Poel.

By saving steel from landfills and preventing polluting particles from entering the environment, PMC's factory turns what was once hazardous or contaminated steel waste into a new product: purified steel blocks ready for use again as a raw material. "Our purified steel block can be used in shipbuilding and greening the shipping industry." According to van de Poel, for every kilo of steel produced, PMC is able to save one kilo of CO_2 emissions.

As its first plant in the Netherlands tries to reach full production capacity, PMC already plans to expand and build four to five more plants across Europe. However, it faces a tough opponent. "The black market for illegal handling of contaminated steel scrap is rising, and selling steel with asbestos and other SVHCs is very profitable," says van de Poel. "The biggest beast that we are fighting is criminality, and therefore law enforcement must be strengthened".

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CMT

FRANK GEERDINK

INTRODUCING THE CMT DIACUTRON

BY PILAR GIANNI RODRÍGUEZ & BENEDETTA MANTOAN

Circular Maritime Technologies (CMT) aims to revolutionise ship recycling by delivering clean steel thanks to an automated, low carbon, contained and circular process that does no harm to workers or the environment.
The brainchild of Frank Geerdink at Aseco Europe, an offshore engineering firm and consultancy, the CMT project will soon launch its proof-of-concept prototype in the Netherlands. Following an innovative business model, CMT will set up yards with international partners and attract business from shipowners by matching the price paid by South Asian competitors.

Can you explain CMT, and how it began?

Frank: CMT is born out of the necessity and urgency of providing a solution to the problem of ship scrapping, which continues to pose risks to people's health and the environment. We strongly believe that the technology that we have available today offers the opportunity to take humans out of the equation when scrapping a ship.

At the CMT yard, no human lives will be put at risk as the ships will be taken out of the water and dismantled by a mechanised and automated system. This is realised by a pre-engineered sequential industrialised set of systems, techniques and methods.

In a system where there is a lot of investment and operational capital, you have to design your system in detail, bringing together technologies to provide the solution. This is how the CMT yard and project were conceived and born. CMT will be the solution to ship recycling by making ethical circularity its leading factor.

What were the project's major milestones?

Frank: The project has developed in three phases. First, we had to adopt certain technologies at an early stage, validate them and adapt them accordingly.

Second, we developed the business strategy. From our experience talking to the major players in ship scrapping, we are convinced that we need to pay the Indian price to shipowners to be confident that we will get the biggest ships at the CMT yard. It is crucial to get the ships in order to be able to make a difference in the shipping world. Therefore, during the entire business case, both on the revenue, cost and investment, we have taken this as the main point of conceiving the idea.

Third, we had to bring together existing technologies and produce combinations of new and old technologies that would give us sustainable and circular ship recycling. We used the knowledge that exists within many companies individually and brought it together.

Could you give us an overview of how CMT works?

Frank: First of all, CMT will provide maximum safety for humans and the environment as no open fire or hot work will be deployed in any process. Processes must be mechanical, automated and free of humans. We will also take the ships out of the water to a dedicated plot with all the facilities necessary. We will be selective by purchasing ships directly from the owners; no cash buyers or brokers will be involved.

The CMT Diacutron machinery is the first stage of the ship dismantling process, reducing the size of the ship without direct human involvement. The CMT Diacutron will cut the ship into slices and blocks using a large cutting wire developed for the purpose. The Alpha Wire will cut the ship into slices; every 2 hours it will cut one slice of 300mT. Two wires will cut simultaneously, with one upper wire cutting from the top to the halfway point and one cutting up from the bottom. The ship is then moved forward onto the ship transfer system. While one ship is being cut up, the next will be prepared to be lifted out of the water. The cutting is accompanied by huge volumes of water that is constantly recycled after cleaning and that cools down the wire.

By cutting the ship into slices, we will be able to convert the ship back into its basic elements: steel, recycled products and energy carriers like liquified natural gas (LNG). Although the ship cutting takes place in the open, people and the environment are well protected. All activities are shielded and/or protected from the exterior. Fresh water is permanently recycled and replenished by rainwater. The waste found on the ships, both liquid and solid, will not leave the yard. Instead, it will be converted into gases that are turned into energy carriers.

The driver of the whole process is circularity, as it is a great business case. Even the equipment being used for dismantling and recycling at the CMT yard is second-hand, as it is refurbished and made fit to operate again. We try to avoid using new equipment as much as possible because that would have sustained steelmaking in the wrong way.

Another feature of the CMT yard is that we don't have any diesel or petrol engines running, everything is electric-powered. All waste derived from the ships will be processed at the CMT yard in the Pyrolysis Conversion Unit (PCU), meaning that no waste will leave the yard.

All organic waste is sorted into liquids and solids. The solids are processed in the PCU which heats the materials to 800 degrees Celsius in the total absence of oxygen. The PCU is very efficient and produces huge volumes of hydrogen and other elementary gases, which will be collected, separated and stored for sale or reuse for the onsite production of electricity, hydrogen or LNG. CMT will provide a maximum reduction of CO_2 and air pollution due to the total absence of off-gas producing processes and by deploying truly circular processes.

There has been a standstill on any kind of major developments over the last 50 years in the ship scrapping industry and we cannot allow ourselves to look and not act; we have to act. CMT has said that if we act, we will act the whole way, until the point where we can say we have achieved our maximum potential

Steel is the most valuable material recovered from ship dismantling. How did you include steel recycling in your business model?

Frank: The CMT yard runs on its own power and produces clean steel. The yard will reduce the size of the vessel step by step through various automated tools, up to the point where each part of the ship's steel structure is reduced to many small pieces.

One unique feature of the yard is that we go from a 3D structure to a 2D material package. This process is executed quickly and precisely, managed by tailored control tools and software, but overseen by specialised CMT staff. Humans control all the systems and processes from a single point, "the Brain", which organises timing and production. The volume of materials retrieved and produced have their own price, so the volume of these products multiplied by their price will be the revenue of the CMT yard.

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One CMT yard will produce about 1.1 million metric tons of 100% clean and homogenous steel each year. This is the equivalent of about 70 large ships or 110 smaller ships. Additionally, about 40 000mT of non-ferrous material will be produced per year, with copper about 70% of that amount. Steel off-takers, those who buy the steel, can order a certain quality of steel. If they want 100 000 tons of steel grade 355 they will get this by our delivery system, the Standard Transport Box.

The Standard Transport Box (STB) is always loaded with 30 tonnes of metal, of which the composition is guaranteed 100%. The STBs will reduce the cost of transporting the steel substantially. They can be stacked eight high, fitting 240mT in 15 square metres, a huge advantage for steel producers' logistics. The STB has only 1/5 of the cost price of transporation, and that makes it highly interesting to both steel off-takers and the off-takers of other products to purchase from us. We can deliver the STBs by train, ship or, for smaller quantities, by truck.

Every box delivers 30 tons of pure material. Purification will be a big contribution to green steel from our side and a huge drive forward in terms of quality and quantities. We will also make sure to sell ship equipment for reuse whenever possible as part of our circularity awareness-raising. For example, at the moment we have two engine manufacturers that have asked if they can purchase the main engines of the ships we dismantle, as these are completely undamaged by our cutting process and can be reused when refurbishing a vessel. This prevents 3 000 tonnes of steel from being melted down.

Which obstacles did you have to overcome when establishing CMT?

Frank: The biggest obstacle is always that when you present the concept, people say, "This is not going to work, we do not do these types of things in this industry." In my professional life as an entrepreneur, I have encountered these obstacles every time I present a new product or solution. There is only one real way to get over these obstacles: to deliver the physical proof to your project. No one would have believed Steve Jobs if he had presented his ideas for the iPhone in 1995, and that's why when he launched it he took the world by surprise. This is what we want to do at CMT, take the world by surprise and completely change the future of ship recycling.

Currently, we are in the process of delivering the hard evidence in a full-size demonstration project, which is named the Test and Demo phase. In a dry dock, ships will be dismantled, starting with a small ship. Over six months, we will provide hard evidence to the international shipping industry, investors and the general public. We are testing the principle of being able to cut a ship in slices and to cut the slices into blocks, and have these blocks processed by fully-automated robotic systems that clean it.

Why do you believe CMT will be key to revolutionise the future of ship recycling?

Frank: There has been a standstill on any kind of major developments over the last 50 years in the ship scrapping industry and we cannot allow ourselves to look and not act; we have to act. CMT has said that if we act, we will act the whole way, until the point where we can say we have achieved our maximum potential. CMT can no longer accept that the ship recycling business exists as it does at present. We want to change it for the better; for people, for the environment and for the world. With the CMT yard, ship owners will receive high value for their old ships and have the option to dismantle them in a way that contributes to the circularity of materials and protects humans and nature from pollution.

A RAY OF HOPE: GREENPEACE'S NEW SHIP RECYCLING POLICY

BY PILAR GIANNI RODRÍGUEZ & BENEDETTA MANTOAN

In line with Greenpeace International's new ship recycling policy, its M.V. Esperanza has been sent for dismantling in one of the EU-listed yards in Spain. This overview of the recycling process extends from the shipowner's considerations before selling the vessel to recycling the material onboard.

The same way every new year invites us to make space for new opportunities, the beginning of 2022 saw the retirement of an iconic ship from the Greenpeace International (GPI) fleet, Esperanza (Spanish for 'hope'). Built in Gdansk in 1984, as an ice-class Russian firefighting vessel, the Esperanza was acquired by Greenpeace in 2000 and registered under the Dutch flag. The ship served Greenpeace campaigns through expeditions from the Antarctic to Alaska to the Philippines. At the start of this year, Esperanza was sent for dismantling in compliance with the EU Ship Recycling Regulation to an EU-listed yard in Spain's Asturias region.

Following the unfortunate end-of-life management of Greenpeace's Rainbow Warrior, which was donated to another NGO for use as a hospital ship in the last years of its life and was then sent to scrap on the beaches of Bangladesh, GPI adopted a recycling policy aligned to its values and campaigning ethos.

The organisation developed its ship recycling policy from a range of fundamental principles. First, under no circumstances could the vessel be beached. Today, more than 70% of end-of-life ships end up being broken on three beaches in India, Bangladesh and Pakistan, at devastating costs to the local communities, workers and the fragile coastal environment.

The second principle was consistency with the best available ship recycling legislation, currently the EU Ship Recycling Regulation (SRR). The SRR has been applicable since 2018 and requires all commercial EU-flagged ships greater than 500 gross tonnes to be recycled in an EU-listed recycling yard, complying with the highest environmental and occupational health and safety standards.

Another priority for GPI is to regularly update its Ship Recycling Policy, in close collaboration with experts, such as the NGO Shipbreaking Platform and Basel Ban Network. Last but not least, the principle of "reuse before recycling" has been integrated into the design process of the internal ship recycling standard. For example, Greenpeace repurposed its ship, MV Greenpeace, by restoring it to its original form as an ocean tug, Elbe, which is now displayed as a museum ship in Maassluis, Netherlands.

After research, GPI shortlisted 5 yards from the EU list before selecting Decontamination, Dismantling and Recycling (DDR), located in Gijón in the Asturia region. DDR was created over 10 years ago when founding partners Antonio Barredo and Jesus Picatto decided to develop a business model inspired by Picatto's experience in managing end-of-life vehicles. However, DDR's pathway has not been easy. "There is still a lot of stigma surrounding the ship recycling business. A lot of people were against DDR at first, but by complying with all of the European regulations and Spanish authorisations, we proved that ship recycling and waste management can be done responsibly," Antonio says.

© Pierre Baelen / Greenpeace

As well as being an EU-listed yard, DDR follows Spanish rules on carbon emissions and water pollution control. In addition, GPI's International Operations Director Fabien Rondal explains that DDR accepted GPI's request to not resell Esperanza's high-emission diesel engine. Secondly, for monitoring, the two parties agreed to periodic reporting activities, including scheduled visits by a recycling specialist hired by GPI.

Before the end-of-life vessel arrived at the recycling facility, it was necessary to complete and review the Inventory of Hazardous Materials (IHM) present in the ship's structure. GPI started compiling the IHM in 2011, and brought it into compliance with the EU SRR in 2019, obtaining approval from the classification society DNV.

From 2011 to 2019, GPI conducted surveys, sampling and training for the crews related to the Esperanza IHM. Documentation regarding hazards in stores and wastes is used to help the recycling facility formulate a safer and environmentally sound plan for their removal and disposal.

At the time of writing, Esperanza is undergoing asbestos removal. One of the most common hazardous materials found on ships, asbestos is typically found in engine rooms and between steel plates. Although asbestos was banned by the International Convention for the Safety of Life at Sea (SOLAS) in July 2002, recent estimates indicate that it is still found in over 65% of vessels, including 50% of all new-builds.

Once the asbestos has been completely removed by a specialist company, DDR will start handling the other waste and materials. Exterior loose waste is divided and categorised into three main groups: loose reusable materials, normal waste and hazardous waste.

Firstly, reusable materials (e.g. ropes and ladders) are checked and sold second-hand. Second, non-toxic waste (e.g. wood, steel, plastic, etc.) is separated and recycled according to regional rules. Around 2% of the total waste cannot be recycled, which in the case of Esperanza equals around 40 tonnes of waste.

For toxic waste, DDR needs authorisation from the competent harbour, to which it presents a list (including the IHM) of all the toxic materials that the company is going to remove. This list needs to include, for example, the disposal of the fuel, engine, ballast water, bilge waters and other liquids. Different types of toxic waste are handled by different waste management companies, with whom the recycling yard needs to sign disposal contracts. These facilities will sample and analyse the waste, and declare it to the yard in a document that outlines the disposal and treatment process.

As has been shown above, reliable handling of hazardous waste and safe ship recycling is possible. So what can other shipowners and companies do to ensure they follow best practices? According to Rondal: "Companies should adapt their business model and integrate the cost of safe-recycling, instead of arguing that they do not act because of a lack of regulation. Following this logic, Greenpeace, over the last 10 years, has gradually put aside a specific budget in preparation for the recycling of the vessel." GPI shows that the safe recycling of end-of-life assets can be planned far in advance. Approved yards such as the Spanish DDR are ready to accommodate shipowners' tonnage and treat it responsibly, employing the latest technologies and in accordance with national and regional waste management regulations.

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THE EUROPEAN GREEN DEAL AND STEEL

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BY ANNA GUMBAU

The EU's landmark Green Deal presents many promising policy and financial incentives to decarbonise and circularise steel production, providing the EU with additional reasons to boost sustainable ship recycling capacity and opening new perspectives on the value of scrap steel from ships.

Since the European Commission presented the European Green Deal in late 2019, Brussels has been flexing its muscles to make decarbonisation and recycling in the steel sector a reality. This would spur the availability of scrap steel in Europe and complement EU rules on ship recycling.

In the coming months, the European Commission – the EU's executive arm – is expected to present an evaluation of the EU's Ship Recycling Regulation, which was adopted in 2013 and fully entered into force in 2019. Revisions to strengthen the Regulation are on the horizon.

Simultaneously, reforms to the EU's energy, climate, and circular economy legislation – currently in negotiation - have placed clean fuels and carbon pricing centre stage in discussions on how to decarbonise shipping. This will encourage the building of new vessels that produce lower emissions than older tonnage, and prompt policymakers to reflect on how policies to mitigate climate change support circularity for end-of-life ships.

Several pieces of legislation currently being reformed could prompt the steel industry to lead the way among energy-intensive industries in decarbonising and becoming fully circular, with the right mix of policy and financial instruments to spur ferrous metals recycling and invest in zero-emissions steel production. These include the EU's circular economy action package, the EU's taxonomy regulation, the reform of the EU emissions trading system and the revision of the bloc's waste shipment rules.

Decarbonising steel would have a significant impact on the EU's emissions reduction objectives. According to European Commission estimates, the EU steel industry accounts for around 221 million tonnes of greenhouse gas emissions annually, considering both direct and indirect emissions. This is equivalent to 5.7% of the EU's total greenhouse gas emissions.

"To meet the ambitions of the European Green Deal, the steel industry has to transform itself in order to stay competitive," the European Commission said in a working document, 'Towards competitive and clean European steel', published in 2021.

But the European Commission also acknowledges that "2050 is just an investment cycle away" for the steel sector, and so Brussels is speeding up regulations to ensure it is among the first hard-to-abate sectors to decarbonise. Retaining scrap steel will play an important role in achieving that goal.

Bottlenecks in recycling scrap steel

Steel from ships is already being recycled. However, rather than coming back into shipping, it usually goes to local industries close to where the ship is dismantled, says Andreea Miu of the Sustainable Shipping Initiative (SSI). Currently, the vast majority of vessels end their operational life on beaches in South Asia.

Eurofer explains the process: "Third countries that - due to lower environmental, climate, health, safety and social standards - don't bear the same costs as EU countries for processing waste, are in a position to offer bigger returns to waste traders. In such a situation, environmental and social challenges are basically exported abroad and de facto leaked to third countries, while valuable circular resources, which are also key for the EU's climate and environmental ambition, are lost to the EU."

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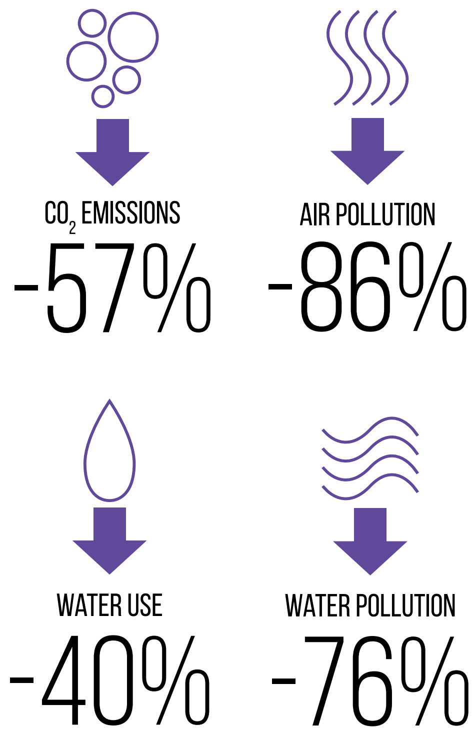
According to Eurofer, scrap steel from ships is considered high quality secondary raw material for further reprocessing within steel plants. But it is often contaminated and is hard to separate from other metals. "As certain categories of steel products can tolerate a relatively high level of residues, separation is not always carried out to the maximum level possible, or different grades of scrap are even mixed together," according to a report from Brussels-based NGO Sandbag, released in June 2022.

Difficulties in separating scrap steel make it harder to retain and recycle scrap in Europe, thus increasing the volume of exported scrap. In 2020, 24 million tonnes of scrap were exported from the EU, a figure expected to increase to 31 million tonnes by 2030, according to a business-as-usual scenario. According to the Sandbag report, those 31 million tonnes could be entirely recycled in Europe, using new electric arc furnaces, which will replace older, more pollutant, blast furnaces.

The Sandbag report found that optimising the use of European scrap steel could reduce the sector's annual demand for fossil gas (or hydrogen) by 60%, to 7.5 billion cubic metres for the EU and UK combined, thus saving 126 terawatt annually. Using scrap steel in EU steelmaking would also reduce the industry's CO_2 emissions by 57%, air pollution by 86%, water use by 40%, and water pollution by 76%, according to EuRIC's Metal Recycling factsheet.

IMPACT OF USING SCRAP STEEL IN EU

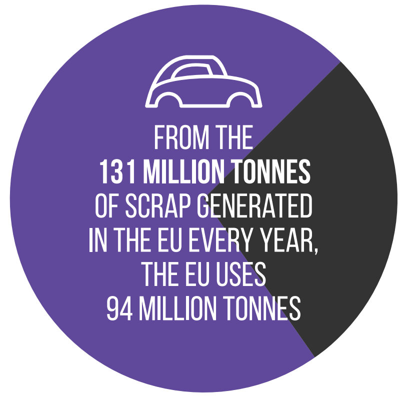


Source : EuRIC's Metal Recycling factsheet

Circular economy policies will be crucial to make more scrap steel available. According to the Sandbag report there are several ways to achieve this, including product design and a more stringent carbon price in the EU's emissions trading system. The report also highlights that scrap quality is currently assessed by imprecise visual inspection, whereas equipment that improves material sorting and handpicking efficiency before scrap is melted is already available and being used by certain scrap processors and steelmakers. Using optical recognition and artificial intelligence, scrap processors are able to better identify scrap quality grades, as well as collect other precious materials such as copper.

A highly circular material

According to European Commission estimates, the EU already recovers 85% of end-of-life steel for recycling:



Source : European Commission

In its 'green steel' roadmap report, 'Towards competitive and clean European steel', the Commission suggested that the ferrous metal could "become a nearly fully circular material," with the necessary policies in place.

"By the 2050s, [...] the amount of scrap available in the EU could be as large as total EU annual steel needs, raising the interesting prospect that recycling could satisfy a large part of the EU's steel needs, if the quality is good enough," the report said.

In 2020, the European Commission presented its Circular Economy Action Plan. Two packages of circular economy legislation have been presented in 2022 – one on broader sustainable products in March, and a second on circularity of plastics, in July.

Among the items of legislation presented in March 2022 was the Sustainable Products Initiative (SPI), which expands the scope of the EU's ecodesign rules to a wider range of products, with the aim of making all products entering the EU market more durable, recyclable and reparable.

While the SPI presents the general framework of the new circular economy rules, it is expected that the European Commission will propose sector-specific legislation. Products covered under these rules will have to contain a digital product passport outlining the product's life cycle environmental footprint, as well as the share of recycled content and other related indicators specifically for steel and steel-based products.

"This may lead to the definition of classes of environmental performance, and to measures to promote the uptake of low-carbon and sustainable steel in the EU market(s), including through minimum sustainability requirements in public procurement," the European Commission said.

According to Sandbag, decisions related to product design "must be made urgently" to ensure the sustainability of scrap recycling: "Designing products for easier recycling at end of life and easier removal of contaminants will ensure a better, higher quality scrap supply."

"Optimising the use of scrap would mainly require better segregation of scrap categories […] and better assessment of scrap quality for which the technology is available and inexpensive," its report said.

The steel industry agrees that there are benefits to using scrap steel. "One of the main benefits for the steel industry is that for every tonne of carbon steel scrap recycled, a saving of 1.4 tonnes of CO_2 is achieved," says Eurofer.

"In the case of stainless steel scrap, the saving of emissions is even bigger, close to 5 tonnes of CO_2. The use of scrap also helps to preserve virgin raw materials, energy and water. It also reduces air, soil and water pollution when processed and utilised in an environmentally sound manner."

Integrating ESG criteria

Greening the EU's industrial value chain will require massive investments in costly technology, i.e. necessitating high capital expenditure. Global steelmaker ArcelorMittal estimates that decarbonising its facilities in Europe alone would require between 15 and 40 billion euros – and these investments would not be profitable before the 2030s.

As sustainable finance gains prominence across industries, more and more steel firms are eyeing green and sustainability-linked bonds to access long-term funding, including India's JSW Group, US Steel, or Austria's Voestalpine.

The EU is looking to set the 'gold standard' in sustainable finance with its taxonomy criteria and the EU Green Bonds initiative.

Steel production is included among the EU taxonomy activities, with the objective to incentivise low-carbon steel production. Technical screening criteria will recognise the lowest-carbon forms of production, and will ensure compliance with the 'do no significant harm' (DNSH) principle.

However, according to experts at Sandbag, the challenge in enabling zero-emissions steel is not so much about innovative technology but rather access to zero-carbon electricity and better practices in the scrap market. "EU funding… might be more suitable to address these EU-wide challenges than sponsoring individual conversion projects," it says.

Upholding the 'polluter pays' principle

So as not to disadvantage steel companies that invest in low-carbon technology, the European Commission has proposed to gradually reduce the free allocation of EU allowances under the EU Emissions Trading Scheme and remove them by 2036.

To protect the competitiveness of EU heavy industries, Brussels has furthermore proposed to introduce a carbon border adjustment mechanism (CBAM), which will impose a tariff equivalent to the EU carbon price on third-country imports of steel, cement, electricity, aluminium and fertilisers to the EU.

Reviewing waste shipment and ship recycling rules

Another game-changer in the decarbonisation of the shipping value chain and steel sector is the revision of the EU's Waste Shipment Regulation.

The revision aims to stop exports of hazardous waste to third countries and improve the management of waste exported outside the EU. Most waste exported from the EU includes ferrous and non-ferrous metal scrap. In the case of ferrous metal scrap, this is mostly sent to other OECD member countries. With vessels, however, the vast majority of EU-owned tonnage is sold to South Asia.

"The recycling of ferrous scrap in the EU plays a fundamental role in decarbonisation, and this will become more and more relevant in the near future," according to Eurofer. "Therefore, it is essential that the potential of EU recycling is fully unlocked."

"We are in an absurd situation where the EU sets very high environmental standards and circular economy objectives for the internal market – that the EU steel industry fully shares, while millions of tons of valuable secondary raw materials are being exported to jurisdictions where these same standards and objectives are not met," added Eurofer director-general Axel Eggert.

"We cannot afford to give away a key secondary raw material such as scrap, if we want to fulfil the circular economy and climate objectives as well as ensuring EU strategic autonomy and social standards."

Regarding shipping, in particular, if the current European Commission focuses on sustainable fuels and carbon pricing for ships, it is very likely that its successor, from mid-2024, will concentrate on the life cycle sustainability of shipping, including enhancing circular models that can boost the capacity for sustainable recycling of end-of-life vessels.

NGOs and industry alike are hoping for a strong proposal and revision of EU ship recycling rules that ensure sustainability, preservation of coastal ecosystems and labour rights, while also deepening connections that need to be made to ensure shipping and steel sectors that are consistent with cradle-to-cradle design and optimal material recovery.

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NEED TO CREATE AN INCENTIVE

"To my mind, the issue is quite simple: the Commission should make a proposal to amend the Ship Recycling Regulation to propose a financial instrument," said a source who was involved in negotiating the Ship Recycling Regulation in 2012.

NGOs have consistently warned the EU to act quickly, as the EU Ship Recycling rules can be easily circumvented just by switching to the flag of a non-EU country.

A 2017 study by consultancy Ecorys, DNV-GL and the Erasmus University of Rotterdam proposed a ship recycling licence which each ship, regardless of its flag, would need to acquire to enter EU ports.

At the end of the ship's life, the cost of the licence would be returned to the ship's final owner once it has been recycled at an approved ship recycling facility. This would constitute a major financial incentive to boost ship recycling in line with EU standards.

NGO SHIPBREAKING PLATFORM

Since 2009, around 7000 ships have been scrapped in South Asia, causing at least 430 deaths and 354 injuries. The figures on accidents are likely to be much higher. Occupational diseases are not even registered in these statistics and are difficult to monitor.

WE ARE NOW CALLING FOR YOUR SUPPORT TO HELP INJURED WORKERS AND ASBESTOS VICTIMS IN BANGLADESH.
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