# Repurposing ship steel for construction – opportunities, challenges and the way forward

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**SINTEF Community**

# Background

- 52 % of steel is used in construction
  - global production at 1 892 million tons per year, led by China (ca. 50%) and Norway relies on imports.
- Global ship recycling is rising, with steel making up 75 – 85 % of a vessel's weight.
- 90% of ships are recycled in Asia, mainly in Bangladesh, India, and Pakistan
  - often beached, exposing workers and marine life to hazardous chemicals.
- Norway faces higher decommissioning costs
  - a new business model for upcycling maritime steel into building materials.

# Oppsirk - Upcycling of maritime steel

## Goal

- Develop a new circular industry by upcycling maritime steel from ships and oil platforms into low carbon building material.

## Research activities

- Identify barriers and opportunities for circular reuse of maritime steel.
- Develop scalable dismantling and upcycling methods for ships and oil platforms to achieve high upcycling rate.
- Develop industrialized production of building products from maritime steel.
- Establish a Norwegian value chain for low emission, upcycled steel products.

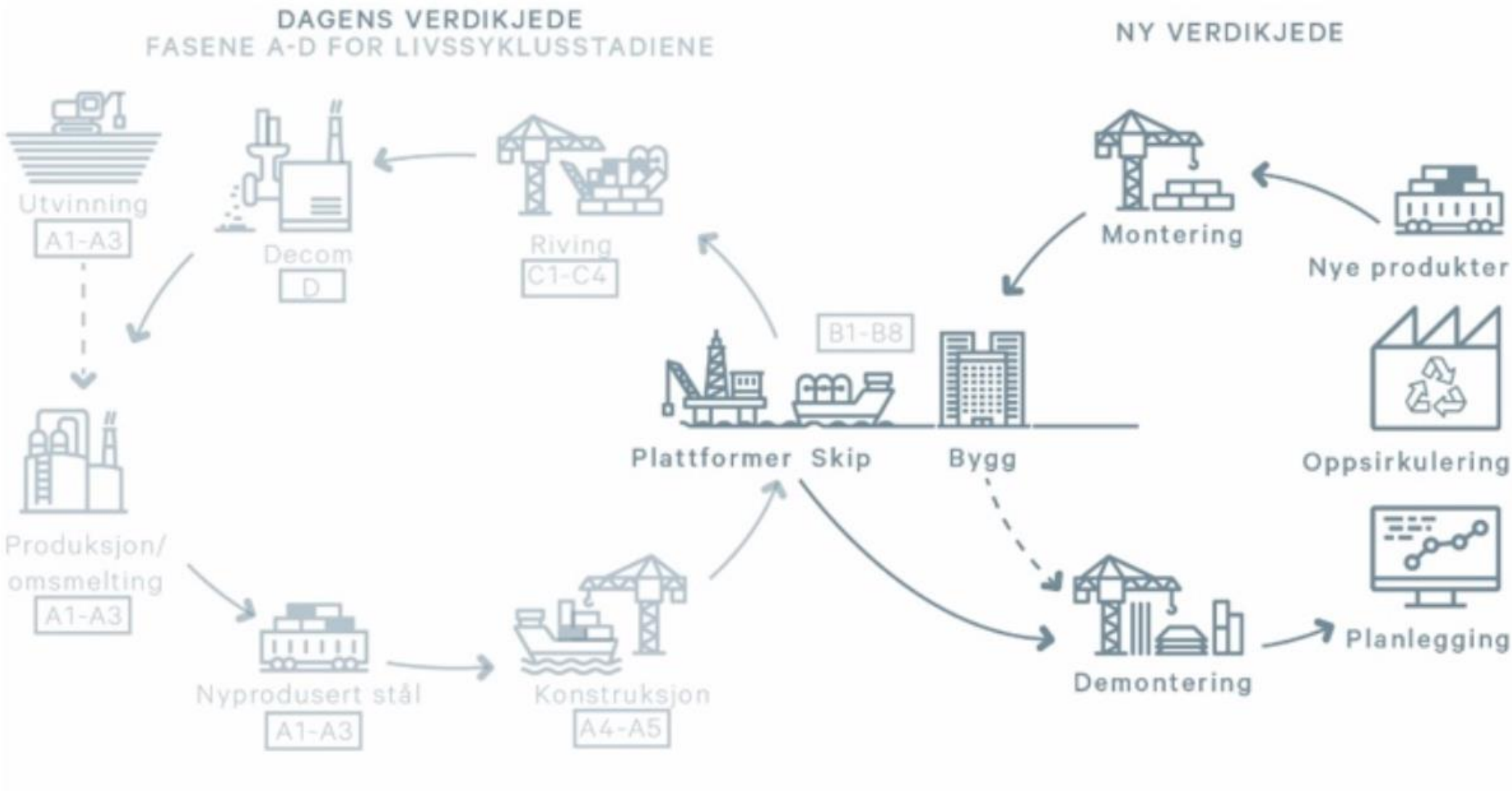
**Project type**: Green platform
**Project period**: 2024 – 2026

https://www.oppsirk.no/about

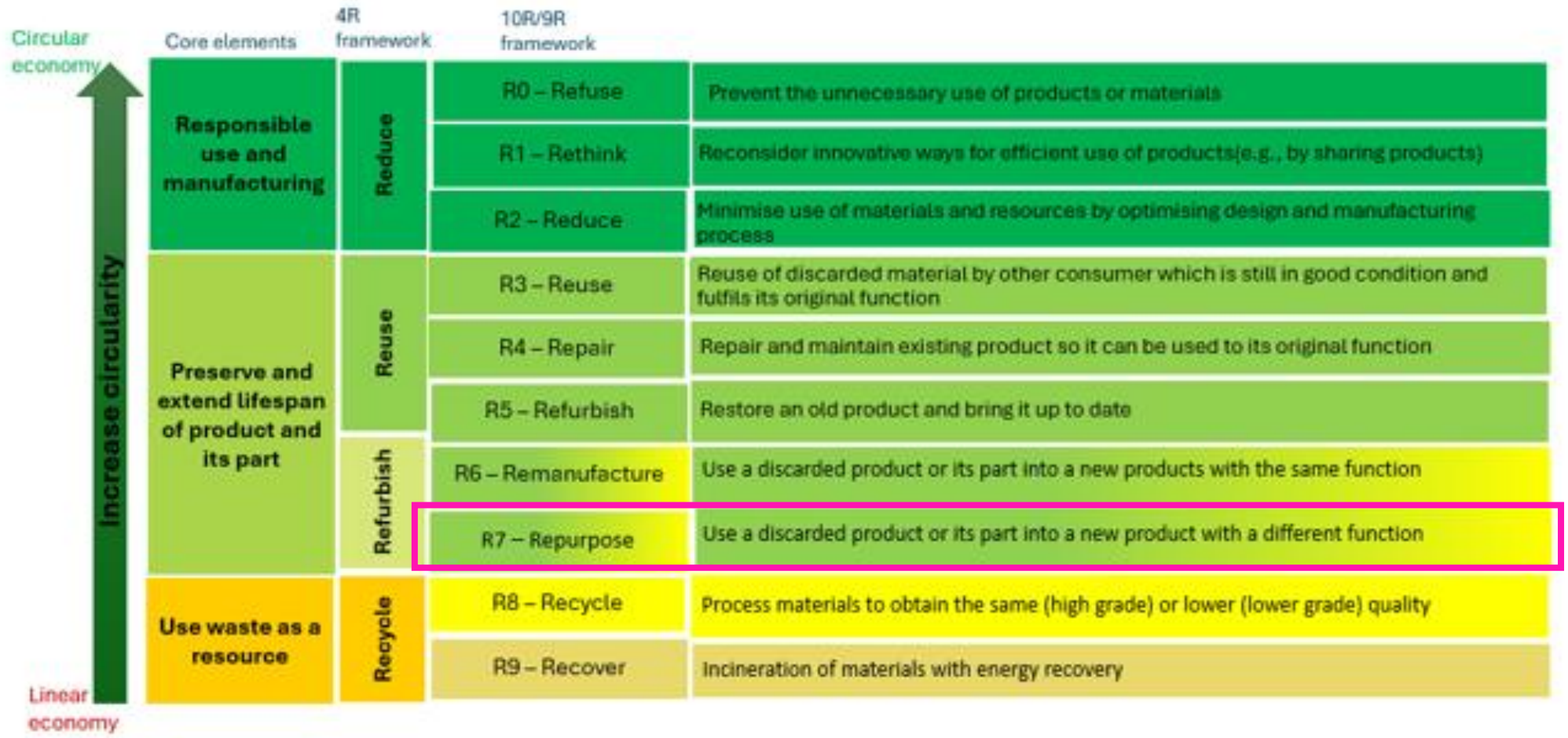
## Partners

AF Offshore Decom AS, Stiftelsen Maritime Bergen, Green Yard Kleven AS, LAB Entreprenør AS, Vill Arkitektur AS, Equinor Energy AS, Oslobygg KF, Statsbygg, Skanska Norge AS, AS Dikkedokken, Stiftelsen Kulturhuset USF, Bara Eiendom AS, Radøygruppen AS, Norges Handelshøyskole, Sintef AS, Sintef Ocean AS, Sintef Manufacturing AS, Node Rådgivende Ingeniører AS, DNB Bank ASA, Future Materials AS, Manufacturing Technology Norwegian Catapult AS, Røynstrand Jacobsen AS

# Oppsirk - Upcycling of maritime steel

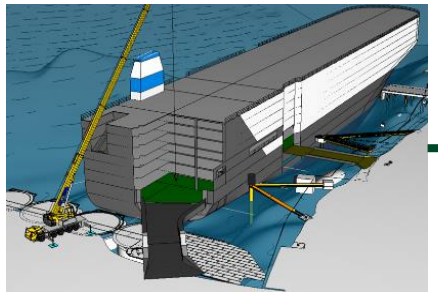


# Upcycling - Circular economy principles



# Oppsirk - Upcycling process

## Dismantling

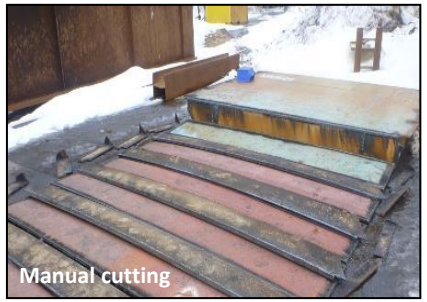


Sectioning with traceability

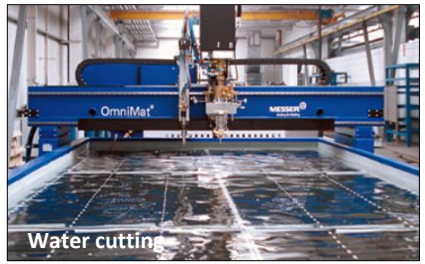
## Internal logistics

Logistics and temporary storage

## Cutting

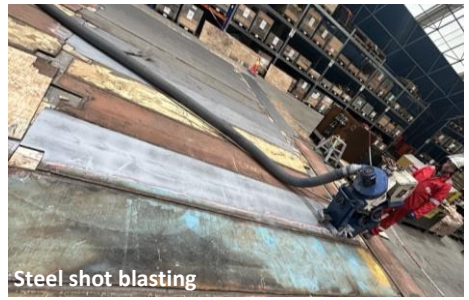


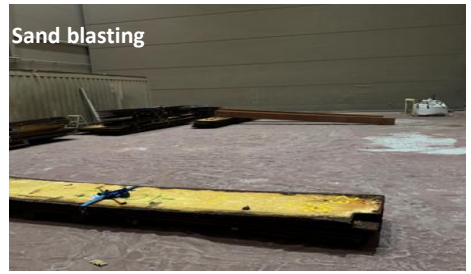






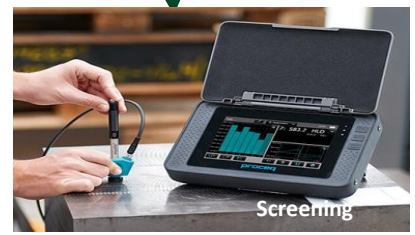
## Cleaning






## Storage, forming/welding, testing & documentation



LCA/EPD

# Purpose of the study

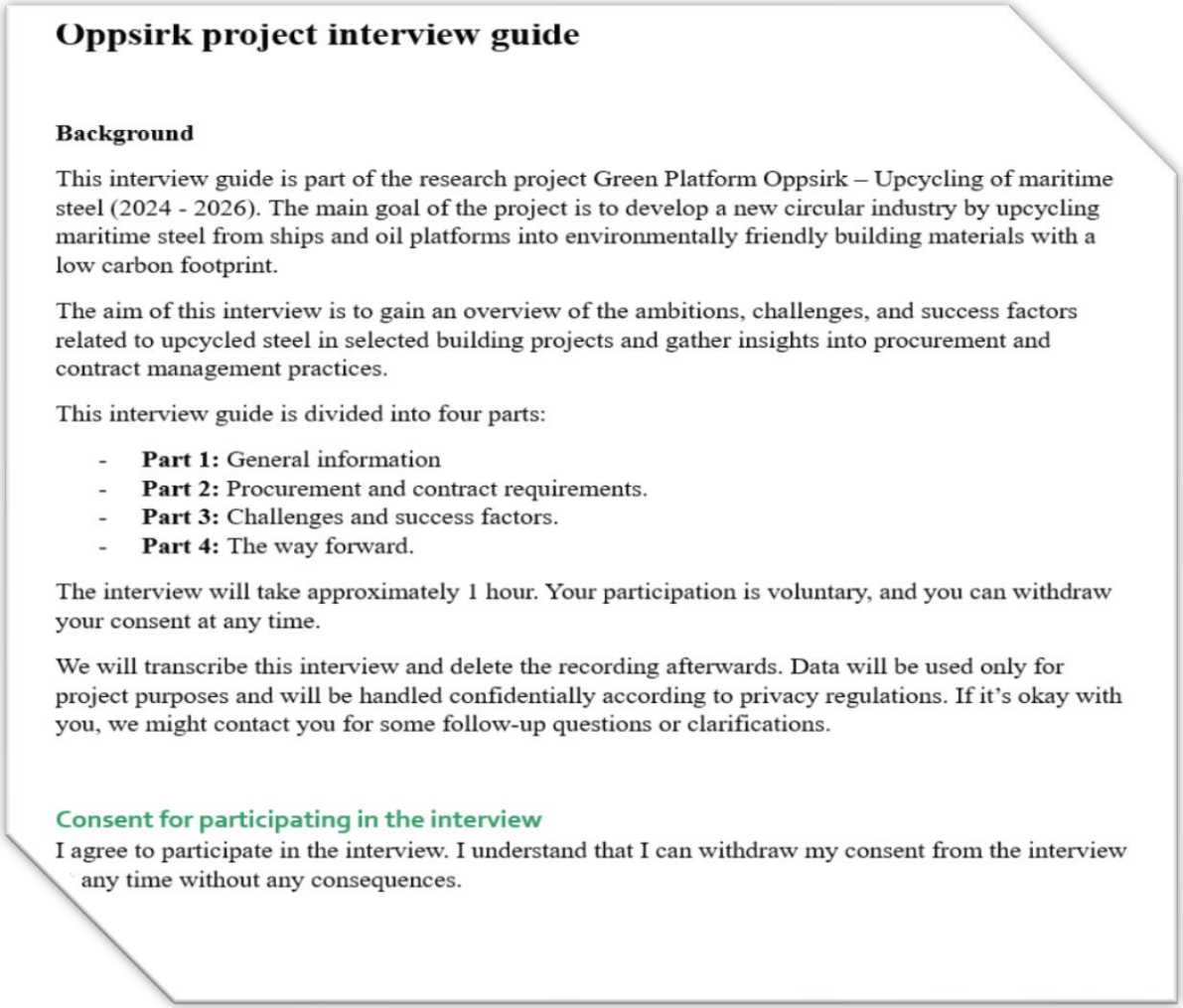
- Aim:
  - To identify ambitions, challenges, success factors and the way forward for upcycled steel, based on lessons learned from pilot projects and insights gathered through interviews with Oppsirk project partners.

- Scope:
  - Focused on pilot projects involving Oppsirk project partners across the upcycled steel value chain.

# Methodology – data analysis

R1- R3 Building owners → R4 Contractor → R5&R6 Decommissioners → R7&R8 Steel manufacturers → R9 Consultant → R10 - Upcycled steel supplier & consultant

Interview format: Semi-structured interviews conducted via Teams (Jan-Feb. 2025)



**Oppsirk project interview guide**

**Background**

This interview guide is part of the research project Green Platform Oppsirk – Upcycling of maritime steel (2024 - 2026). The main goal of the project is to develop a new circular industry by upcycling maritime steel from ships and oil platforms into environmentally friendly building materials with a low carbon footprint.

The aim of this interview is to gain an overview of the ambitions, challenges, and success factors related to upcycled steel in selected building projects and gather insights into procurement and contract management practices.

This interview guide is divided into four parts:

- **Part 1:** General information
- **Part 2:** Procurement and contract requirements.
- **Part 3:** Challenges and success factors.
- **Part 4:** The way forward.

The interview will take approximately 1 hour. Your participation is voluntary, and you can withdraw your consent at any time.

We will transcribe this interview and delete the recording afterwards. Data will be used only for project purposes and will be handled confidentially according to privacy regulations. If it's okay with you, we might contact you for some follow-up questions or clarifications.

**Consent for participating in the interview**

I agree to participate in the interview. I understand that I can withdraw my consent from the interview any time without any consequences.

| Participants: 12 stakeholders across 10 interviews | | | | |
|---|---|---|---|---|
| **Stakeholder roles** | **Pilots** | | | |
| | **P1** | **P2** | **P3** | **P4** |
| **Building owners** | R1 | R2 | R1 | R3 |
| **Decomissioning** | R6 | R5 | R5 | R5 |
| **Contractors** | R4 | NA* | | |
| **Production** | R6 | R7 | R7 | R8 |
| **Consultants**** | R9 | R9 | | |
| **Upcycled steel supplier and consultant**** | R10 | R10 | R10 | R10 |

| Pilot projects | | |
|---|---|---|
| **Code** | **Type of upcycled steel product used** | **Project status** |
| P1 | Sheet piling in the foundations | Completed |
| P2 | HSQ beam in construction of the load-bearing structure | Completed |
| P3 | I beam in construction of the load-bearing structure | Completed |
| P4 | HSQ beam in the load-bearing structure | Under construction |

# Methodology – Data analysis

**Transcription & coding**

- Interviews transcribed and coded using NVivo v14.

**Thematic analysis**

- Themes and sub-themes identified and refined through iterative coding.

**Quality assurance**

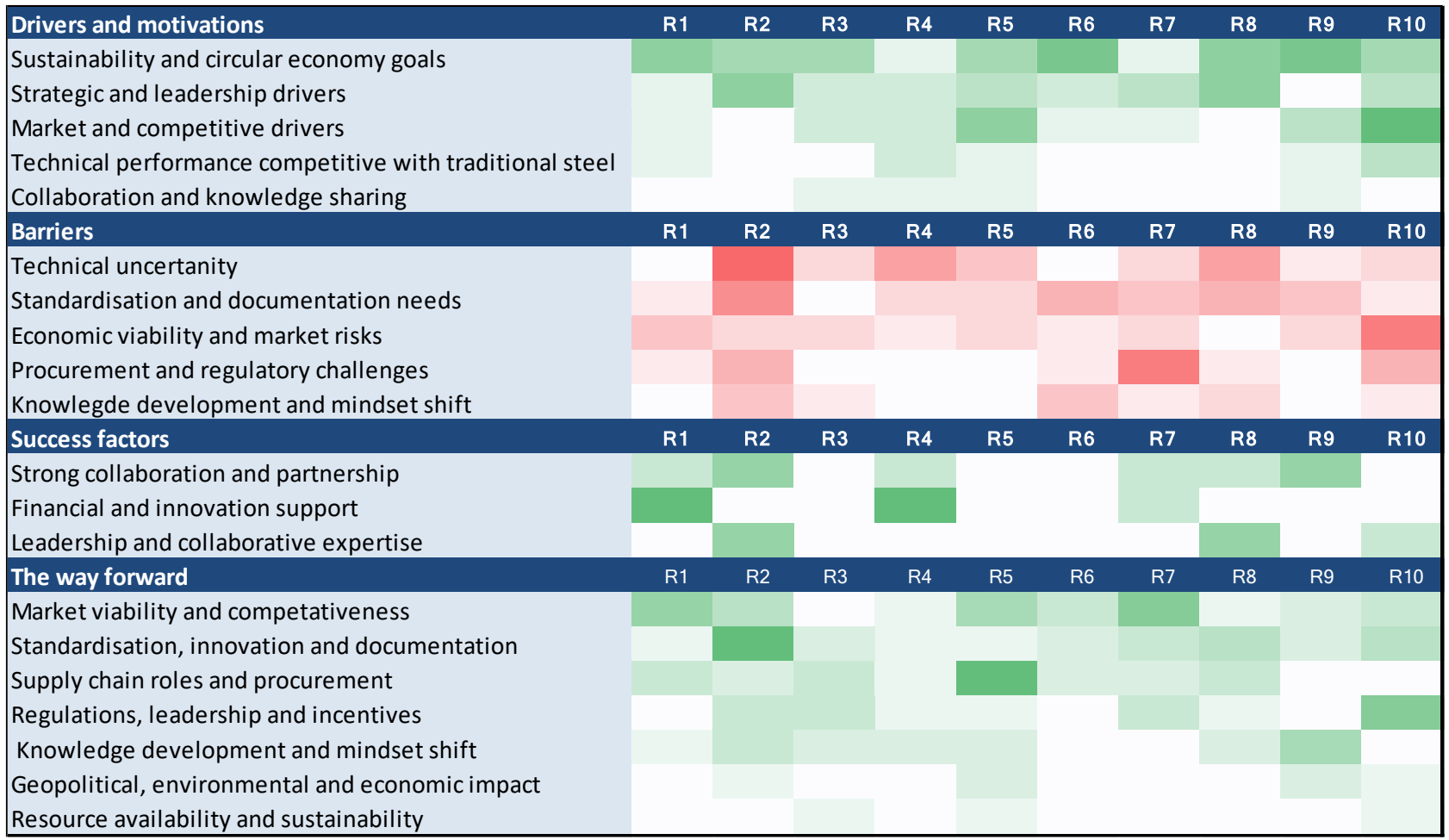
- Coding verified by two researchers present during interviews.

**Output**

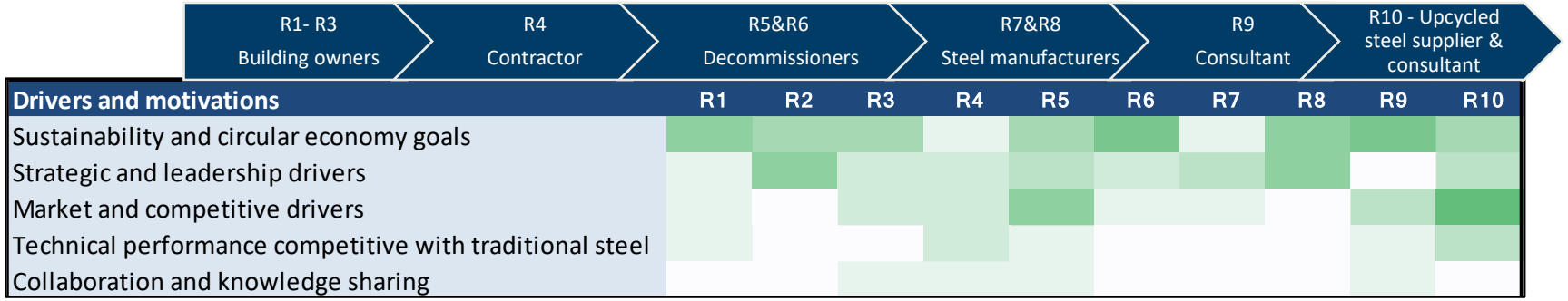
- Coding frequency used to map theme relevance across stakeholders.

# Results

| R1- R3 Building owners | R4 Contractor | R5&R6 Decommissioners | R7&R8 Steel manufacturers | R9 Consultant | R10 - Upcycled steel supplier & consultant |
|---|---|---|---|---|---|



# Drivers for implementing upcycled steel

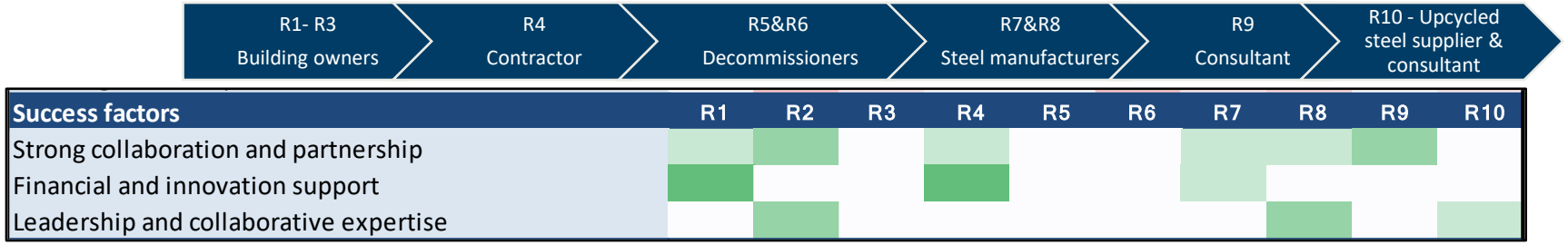



- GHG emission and waste reduction, reuse, local value creation

- Alignment with organisational environmental strategies, innovative procurement
  - *"We never bought any upcycled steel beam as a product. It was not procured as a product, but as knowledge."* - R2

- Enhance brand value, storytelling
  - *"Our ambition is to provide the world's greenest steel, make building products with very low emissions, and change the economy from linear to circular." - R10*

# What makes it work?

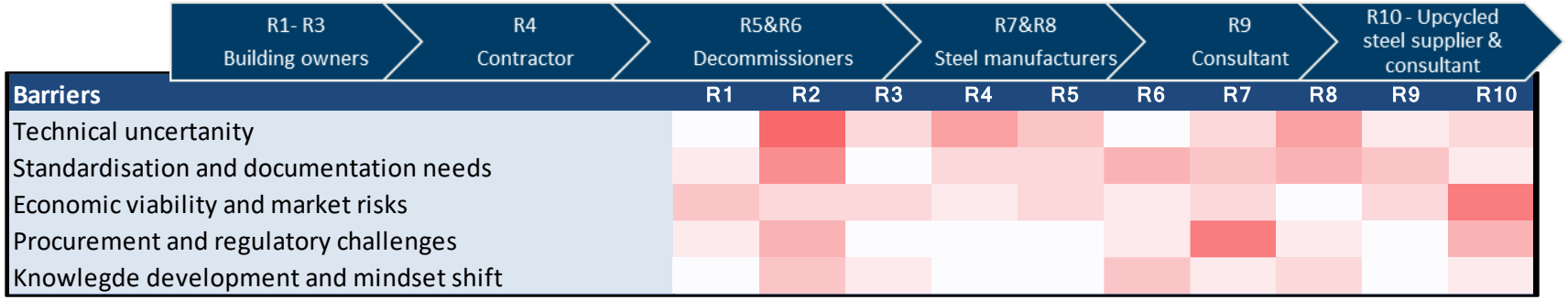



- Open dialogue and shared goals
  - *"The collaboration worked well because we had a common goal and communicated openly throughout the process."* - R9

- Financial backing and low-risk innovation
  - *"It was important that the client was willing to take the financial risk and try something new."* - R1
  - *"The role of the building owner in securing financial support, along with collaboration with the consultant and supplier, were key success factors."* - R4

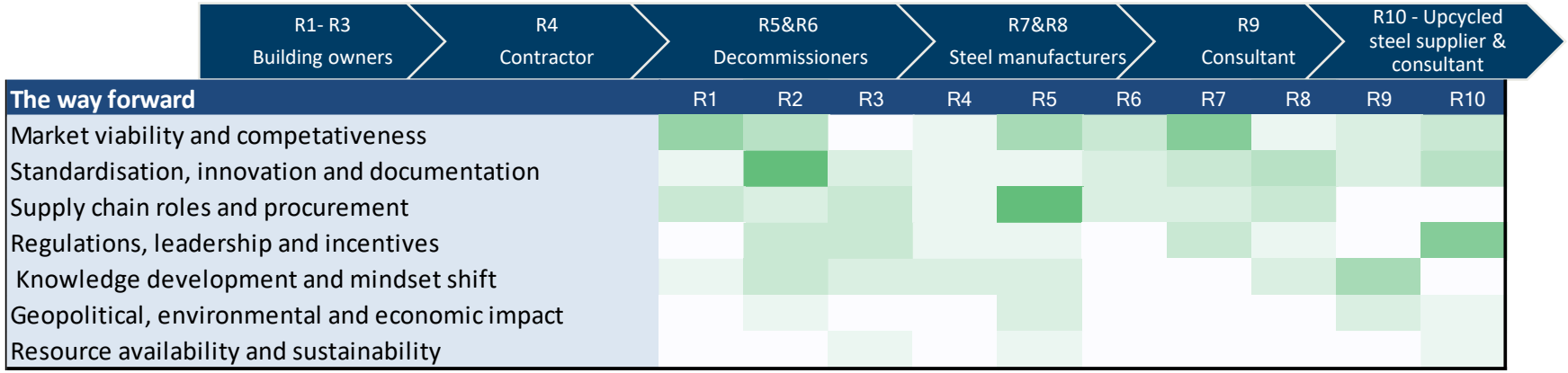
- Motivated leadership and aligned stakeholders
  - *"We feel prepared for taking in the steel plates and have a good plan for what we need to do and how we need to do it."* - R8

# Barriers identified through practice




- Unknown material properties, varying steel quality, reinforcement needs, and paint removal
  - *"The main concern is the unknown lifetime of the material and how it will perform in a building context."* - R2
- Lack of national standards, traceability challenges, insufficient LCA data
  - *"There is no national standard for upcycled steel, which raises concerns about lifetime, load-bearing capacity, and weight."* - R2
- High upfront costs, lack of risk sharing mechanism
  - *"Cost. Cost. Cost."* ….. *"We believe our strategy can yield premium values despite costs."* R10
- Lack of clear regulations, complex procurement processes
  - *"We have to find our own way through the regulations and standards and make our own list of criteria."* - R7

# Key enablers for scaling upcycled steel




- Affordability, quality, strategic use of materials, storytelling builds trust and credibility, mass production
  - *"Upcycled steel is promising if it can match quality and reduce costs."* – R1

- Clear guidelines, standard dimensions and early planning
  - *"We need more data and pilot projects to get smarter."* – R1

- Defining roles, streamlined supply, $CO_2$ based pricing, collaborative contracts
  - *"Everyone should come together to take the risks." – R8*

- *Clear rules, funding, motivations over mandates*
  - *"We need continued research and integration in procurement."* – R10
  - *"The state should lead by example, but certainty is needed first."* – R2

# Conclusion - Advancing upcycled steel in Norwegian construction

- What drives it
  - Strong sustainability and CE goals; strategic leadership; market value and compelling storytelling
- What enables success
  - Open collaboration and shared motivation; financial support and innovation friendly pilots; good leadership
- Challenges
  - Technical uncertainty and lack of standards; high upfront costs and unclear market value; regulatory and procurement complexity
- The way forward
  - Standardise processes and documentation; upscaling and shared learnings; align procurement and policy to support innovation; use storytelling to inspire broader adoption

SINTEF
75 years

Oppsirk

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# Oppsirk is leading the way through impact showcasing the potential of up cycled steel.


## Nordic Circles teaming up with Hoegh Autoliners to recycle up to eight ships in Norway

Billion-kroner scheme to kick-start new upcycling industry in Norway.

Read More

## Laser could replace sandblasting for cleaning of steel

Oppsirk innovation. Laser might replace sand blasting. Reducing emissions and use of energy

Read More

60 Nor-Shipping 1965-2025 Oslo 2-6 June

## Oppsirk is coming to Nor Shipping

Oppsirk consortium is coming to Nor Shipping in June. We look forward to show and share our experience and plan to provide the building industry with up cycled steel, a new profitable model for yards to decommission and deliver a large and reliable source of steel to the EU.

Read More

# Repurposing ship steel for construction – opportunities, challenges and the way forward

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**Abstract.** The construction industry is one of the largest consumers of natural resources and is a significant contributor to energy consumption, waste, and greenhouse gas (GHG) emissions. Steel production accounts for 7% of global GHG emissions, and around half of all steel production is used in the construction industry. Steel is also the primary material used in ships. Norway, with the world's fifth largest fleet, is responsible for the decommissioning of millions of tonnes of maritime steel in coming years. Oppsirk is a research project in Norway that aims to develop new circular business models aimed at upcycling maritime steel into steel products for the construction industry. The aim of this paper is to present the status of upcycled maritime steel use in the Norwegian construction industry, and identify challenges and lessons learnt from pilot projects. This is achieved by interviewing Oppsirk project partners representing the whole value chain. Stakeholders identify sustainability and circular economy (CE) goals, as well as strategic leadership and market competitive values as important drivers for upcycled steel. However, repurposing steel faces several challenges, including technical uncertainty, lack of standardization and documentation, economic viability and market risks, and procurement and regulatory challenges. In conclusion, upcycled steel is an emergent technology, and stakeholders have identified a large scope for further development, including improving market viability, standardising upcycling processes and technical and environmental documentation, clarifying value chain roles in the procurement process, as well as developing knowledge on upcycling and changing traditional mindsets.