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# Evolving Perspectives

Practical Proposals for Resource-Efficient Solutions

IIIEE SSC-REPORT 2022 | LUND UNIVERSITY





# Evolving Perspectives

Practical Proposals for Resource-Efficient Solutions



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## INTRODUCTION

The past two years have highlighted global interdependence and society's dependence on immediate resource availability. The COVID-19 pandemic and the war in Ukraine have revealed that nations, businesses and individuals tend to start acting upon challenges when direct negative impacts are inevitable. What are appropriate strategies for organisations, municipalities or individuals to proactively further sustainability efforts in a holistic manner? Lund University's International Institute for Industrial Environmental Economics (IIIEE) selected eight clients who reached out to receive support in advancing their sustainability efforts. As part of the capstone course Sustainability Solutions in Context (SSC) within the MSc programme in Environmental Management and Policy, students were divided into eight groups to respond with customised solutions to these requests over a one-month-timeframe in October 2022.

The client requests varied greatly and highlighted the global interconnectedness of issues. The projects ranged from business management over urban and transportation transformation, to consumption governance. Despite the broad nature of clients' requests, the commonly shared denominator is a quest for a more efficient use of resources. The students not only applied their knowledge but had the opportunity to provide valuable insights, perspectives and solutions to real-world clients, from private industries to municipalities and intergovernmental organisations around the globe. This volume of the SSC report shows both the need and possibilities to proactively address our most pressing challenges.

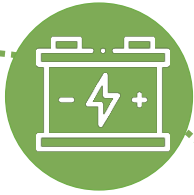




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# **The Biodiversity Impacts of Consumption**





*Ethan, Marta, Gabriele and Ileana*

## Acknowledgements

We would like to express our gratitude to SITRA for allowing us to explore our passion for biodiversity protection through this consultancy project. Special thanks to Dushyant Manchandia (Specialist) and Saara Rimón (Lead Specialist), who served as our primary contacts at SITRA, and to all members of the SITRA team who took the time to meet with and assist us. We would also like to thank Lisa Heldt (PhD Researcher at IIIIEE), our project advisor, for her invaluable guidance and feedback throughout the consultancy. Finally, we want to express our appreciation to the IIIIEE faculty who facilitated the consultancy course, and alumni who provided us with project support.

## The team

**Ethan Dünnerberger** grew up in the U.S., where he studied Criminal Law at Temple University in Philadelphia. With a passion for wildlife conservation, Ethan interned at the U.S. Dept. Of the Interior. After graduation, Ethan worked as a video producer for a documentary film company in Washington D.C., before commencing his studies at the IIIIEE.

**Marta Lamorgese** is originally from Rome and graduated at the University of Glasgow in Zoology. Their studies in Glasgow mainly focused on ecology and human-ecosystem interactions and were complemented by numerous field- and laboratory research experience. Upon graduation, they attended a course in screenwriting at the Roman School of Comics, gaining experience in editing, creative and copy-writing.

**Gabriele Celli** is from Italy, and he holds a M.A. in Philosophy of Language. Keen to work on biodiversity issues, Gabriele did a four-month internship at the national power company of Iceland, where he worked on biodiversity impact mitigation practices. Aside from academic and work experience, Gabriele is a content creator, a former scout chief, and he published several short stories.

**Ileana Graf** is from Germany with Venezuelan roots and did her B.Sc. in Business Administration at the University of Cologne. After graduation, she worked at the German development cooperation in a global project on biodiversity engagement of the private sector and was responsible for the coordination of the Mexican section of the project.

# The Biodiversity Impacts of Consumption

By: *Ethan Dünnenberger, Marta Lamorgese, Gabriele Celli, Ileana Graf*

## Task description

SITRA is a Finnish public foundation that, under the supervision of the parliament, operates independently as a think tank and investment company, with the overarching goal of ensuring a fair, equitable, and sustainable future for all Finnish citizens. SITRA does so by leading strategic research to support governmental decision-making and the creation of events, communication tools, and novel operating models that may better Finnish society's well-being.

The overall aim of our team was to assist SITRA in the preliminary phase of their newest project, “Nature & Everyday Life”: helping citizens understand the impacts of their daily consumption-related choices on biodiversity and propose environmentally conscious alternatives. The biodiversity

campaign would be based on behavioural psychology, marketing, climate, and ecological science, and developed with positive storytelling - e.g., avoiding negative messages that could trigger feelings of guilt or hopelessness.

Upon consultation with our client, the working objectives were set to be:

1. Identify consumption areas and behaviours exerting a clear, substantial negative pressure on biodiversity.
2. Research effective marketing and communication practices currently used by organisations similar to SITRA for spreading awareness of biodiversity issues.
3. Develop innovative solutions to engage and inspire SITRA’s audience, taking into consideration unique features of Finnish culture and mindsets.

Our findings would be used by SITRA to finetune the content and communication of their Nature & Everyday life project.

## Methodology

Following the kick-off meeting with our client, it became clear that in-depth

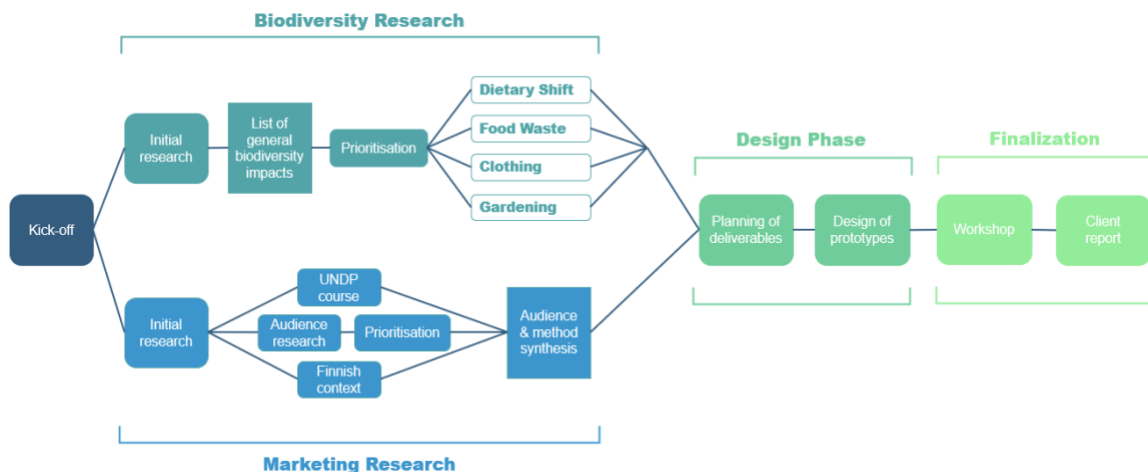


Figure 1: methodological process adopted throughout the project.



research on biodiversity actions as well as marketing options were needed. To be more efficient, our team split into two pairs to target both research areas at the same time (Figure 1). The “Biodiversity Research” pair explored the impacts of citizens' everyday consumption choices, actions and behaviours on wildlife, and biodiversity-friendly alternatives. The “Marketing Research” pair focused on communication strategies to inform citizens of both impacts and alternative actions, looking into practical examples.

After the initial research, involving SITRA's previous work, the biodiversity pair provided a general list of impacting behaviours, which was then scoped down based on the selection criteria shown in Figure 2. Namely: how frequently do citizens engage in the behaviour; how impacting it is; & how well-researched its effects on biodiversity are. The process of prioritisation led to the identification of the four main biodiversity impact domains on which our project focused: dietary shift, food waste, clothing, and gardening.

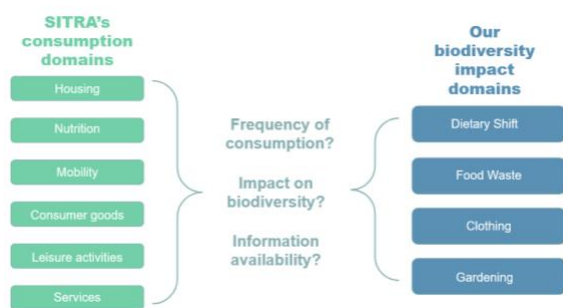


Figure 2: prioritisation in biodiversity research.

As for the Marketing pair, three focus areas were identified:

1. A UNDP online course on biodiversity communication.
2. Audience research: types of consumers, their respective consumption behaviour and which consumer profiles to prioritise.
3. Finnish context: specific mindsets, traits, expectations, and behaviours that should guide the communication strategy.

These three focus areas were further researched in a second step, resulting in an audience and method synthesis (Figure 1) detailing the communication strategies most suited to the various Finnish consumer types for the purpose of the Nature & Everyday project.

The design phase followed, where the team agreed on final deliverables based on the research done by the Biodiversity and Marketing sub-teams. The four biodiversity impact domains were matched with the audience and marketing research to identify and design effective communication solutions - the “prototypes”, which were presented to our client in a workshop held in their headquarters for further refinement.

The workshop had a dual aim. First, to present our progress and future direction; then, to receive their input on how to perfect the prototypes. SITRA's feedback was used to refine our final deliverable: a report covering biodiversity and marketing research, our proposed communication strategy and prototypes, and recommendations for future steps. The present report summarises our findings.

# Biodiversity Research

## Dietary Shift and Food Waste

Considering that the biodiversity impacts in the two domains of diet and food waste stem from the same source, we analysed them in one section. Figure 3 illustrates the ways in which major food types (crops, meat, and seafood) contribute to biodiversity loss, sorted according to whether they are direct or indirect via land conversion.

In short, replacing pristine habitats with farmed land or aqua pens can: isolate wildlife populations from one another, which may result in inbreeding and other genetic issues; and destroy resources essential for the survival and/or life cycle completion of specialist species (i.e., those requiring specific resources or habitat conditions to survive), while creating an environment where generalist, stress-resistant species thrive. The simultaneous

decline in specialists and increase in generalists' abundance associated with farming activities leads to biotic homogenisation, whereby the communities of flora and fauna living in contact with farmed land would become increasingly similar over time and across geographical areas. In turn, this can erode the resilience and resistance to stressors (e.g., a changing climate) displayed by ecosystems, whose functioning may hence be more easily disrupted. Ultimately, biotic homogenisation jeopardises ecosystems' capacity for reliably providing the goods and services our own survival hinges on. Moreover, introduced crops, cattle and farmed seafood can spread pathogens, become invasive and outcompete native flora and fauna. Plus, their farming often introduces pollutants and excessive levels of key nutrients (e.g., N and P in fertilisers and cattle stool), and depletes local water reservoirs. The resulting disruption of nutrient cycling affects the local food web.

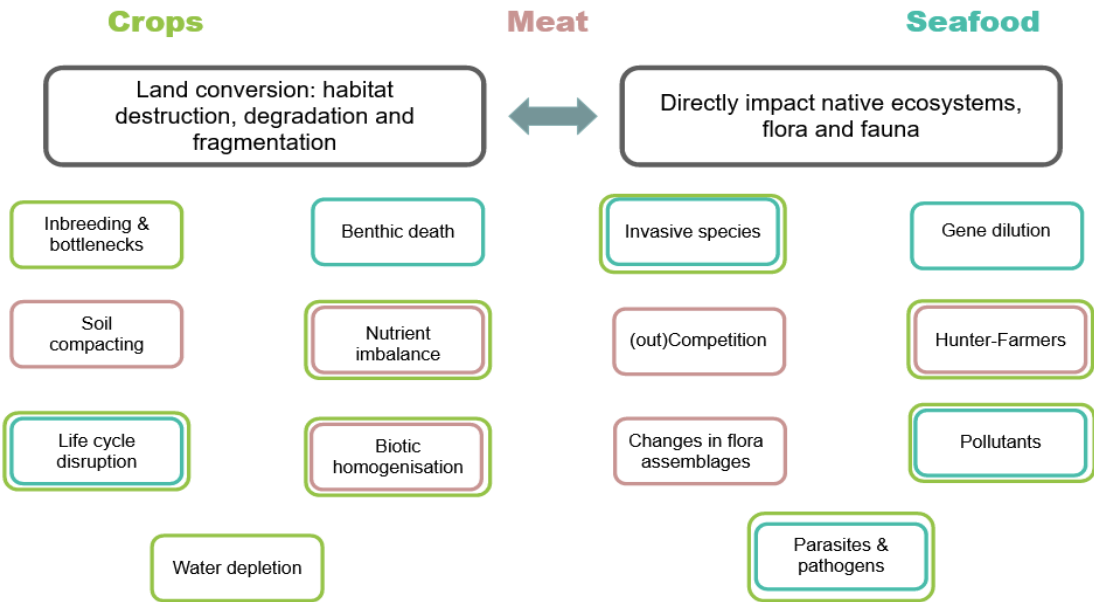


Figure 3: biodiversity impacts of the food production system.



The negative biodiversity effects of agriculture are greater for crops cultivated in biodiversity-rich areas, like cocoa and other tropical commodities, and for animal products, whose farming biodiversity footprint is compounded by that of their feed.

Unnecessary food waste enhances agriculture impacts by inflating food demand to levels above what is actually consumed. Thus, reducing food waste while shifting diets to food products with a lower biodiversity footprint can significantly ameliorate the decline of wild flora and fauna associated with agricultural production.

### Clothing

With fast fashion increasing the demand for new clothes, the impacts of clothing on biodiversity become more frequent and widespread. Negative changes come from all stages in the value chain: raw-material production, fibres preparation and processing, usage, and the end-of-life (Figure 5).

### Gardening

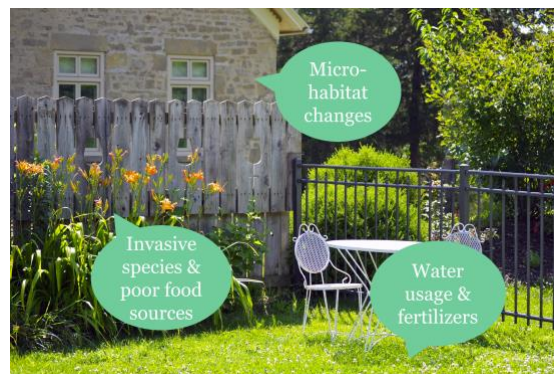


Figure 4: gardening impacts on biodiversity.

Gardening impacts were also chosen because of their direct effects on Finnish biodiversity, thus creating an immediate, close-to-home link between everyday actions and effects on wildlife for SITRA’s audience. Populating the garden with native species can avoid the risk of introducing alien species, attract pollinators and other native insects while providing them with adequate food resources, and help maintain soil quality. Avoiding the creation of structures such as patios and fences helps to sustain natural abiotic conditions.

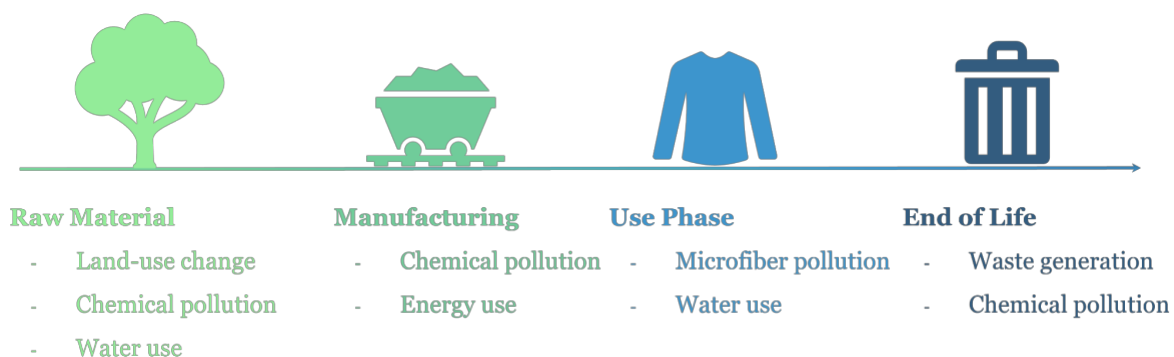


Figure 5: clothing impacts on biodiversity according to life cycle phase.

## Marketing research

The marketing research objective was to explore the array of communication tools used for biodiversity issue topics, categorise Finnish citizens into specific consumer groups, and identify characteristics of Finnish culture and society relevant to the design of a communication campaign.

### Communication Tools

Six main communication categories were identified through the UNDP course: person-to-person communication, print media, community-based education, mass media, mobile devices, and social media. Additional communication strategies were pinpointed by researching academic literature and existing campaigns.

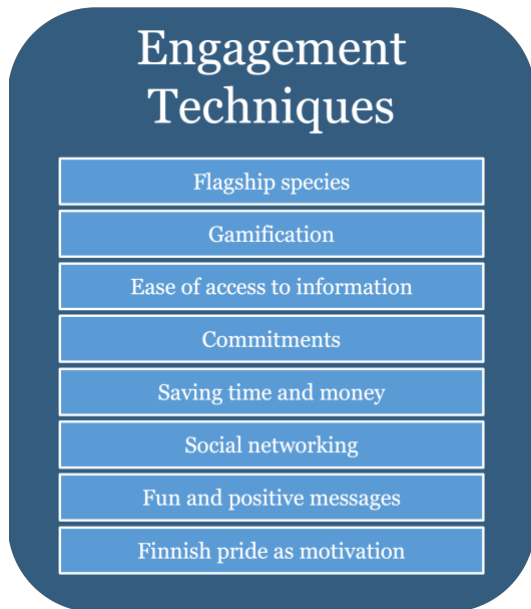


Figure 6: techniques to create engaging biodiversity campaigns in the Finnish context.

Based on the knowledge gained, and the unique features of the Finnish audience, we pinpointed six engagement techniques listed in Figure 6 that were used to guide the design of our digital tool and prototypes - which will be discussed later.

## Consumer Profiles

To determine different consumer types, we relied on SITRA's previous research, where Finnish citizens were categorised into seven "motivational profiles" according to their lifestyle, sustainability habits and motivations to engage in green behaviours.

We focused our research on the following profiles:

- **Ambitious Experience Seeker** (9% of the population). Motivated by new experiences, personal success, and a sense of adventure. Believes strongly in the value of technology.
- **Headstrong traditionalist** (16%). Values tradition and familiarity. Uninterested in modern trends, and critical of wasteful lifestyles.
- **Joyful Everyday Juggler** (21%). Motivated by time and money saving. Look for small daily "joys" and ways to make everyday life easier.

These consumer profiles were selected based on the relative unsustainability of their consumption behaviours, the percentage of the population they represent, and their potential to influence other profiles.

### Finnish Context

The primary objective here was to understand the values and attitudes of Finnish consumers and, more specifically, their perspective on nature and sustainable consumption. A review of



government publications, NGO reports, industry data, scholarly articles, and consumer surveys lead to the identification of six characteristics of Finnish citizens.

1. Appreciation of high-quality information and media that are straightforward, honest, and provide detailed information.
2. Relatively high level of trust in their government institutions. Finnish consumers also see the government as the most important actor for addressing environmental issues.
3. High education level. Far more Finnish citizens have completed upper secondary education compared to the OECD average.
4. They enjoy exploring and gaining information for themselves and are likely to investigate multiple viewpoints.
5. A high digitalisation rates. Mobile phones and social media usage in Finland is high compared to other OECD countries. Social expression increases through digital media, and a large majority of Finnish citizens feel comfortable using digital platforms and devices.
6. They place a high value on nature. There is a consensus about the importance of nature in their lives, and Finnish consumers have a high level of awareness about environmental issues. Studies revealed that a majority of Finnish citizens would be willing to improve the sustainability of their

consumption behaviours if information and guidance was more readily available.

These six characteristics were taken into consideration in the design and ideation of our communication strategies. We concluded that, as a government-associated organisation, SITRA is in a perfect position to establish itself as a central, trustworthy source of information regarding biodiversity issues. Due to Finland's high rate of digitalisation, communication campaigns should primarily utilise digital platforms, and be based exclusively on scientifically-sound sources to appeal to the well-educated Finnish audience. Interactive content and tools that would allow Finnish consumers to explore information on their own should be employed. Finally, SITRA should explore means to ease access to relevant biodiversity information in citizens' everyday life in a unified campaign.

## Outcomes

Our marketing research revealed that biodiversity information is fragmented and communicated across a variety of disjointed platforms. As such, it is challenging for the general public to know where to efficiently access reliable information on biodiversity issues. Furthermore, there is a lack of comprehensive information campaigns which clearly link biodiversity impacts to the broad array of consumption choices that cause them. Because of the Finnish citizens' general trust in their government, and SITRA's recognizable brand, we maintain that SITRA should develop a cohesive information campaign which

combines many different marketing tools under a unified symbol, such as the bear below.



To design specific tools for communicating biodiversity impacts, a synthesis of the biodiversity and

marketing research outcomes was necessary. We addressed the four main biodiversity impact categories described in the previous section and paired them with marketing techniques suited for the three aforementioned consumer profiles.

Figure 7 is an excerpt from our synthesis table, where we formulated marketing tactics for reaching one of the profiles in relation to the food waste impact category.

As Finland is highly digitalized and Finnish people are keen to use digital platforms for ludic and social means, we

Food Waste		
SITRA Profile	Keep track of what you have - avoid excess buying	Mindful Grocery Shopping
Ambitious Experience Seeker	Smart fridge or food tracking app Emphasise newest tech, luxury, high standard	Food pick-up services (grocery stores or third party) High standard, new tool

Figure 7: excerpt from synthesis table.

recommended that a unified marketing campaign should primarily employ digital instruments. Hence, we decided to develop a set of potentially interlinked prototypes of digital communication techniques, which we labelled the “Digital Tool”. We divided the prototypes identified into three different engagement areas: emotional engagement (how to elicit a positive emotional response to the content), informational (how to make citizens reach and assimilate pieces of



Figure 8: example of a Knowledge Library page.



information), and behaviour change (how to make citizens act consistently with the information provided). Each prototype is part of at least one of the three engagement areas. The backbone of our Digital Tool is the Knowledge Library, an archive of information about biodiversity and relevant consumer behaviour. For instance, users can access information pages with facts about seasonality and the biodiversity impacts of certain classes of products (e.g., avocados) on various flagship species. Users will navigate through pages via hyperlinks to gain knowledge about biodiversity and about the impacts of certain products or activities. Figure 8 is an example of an interactive map within the “Avocado” product page which allows users to explore impacted wildlife species in various avocado-producing regions.

In the Appendix we provide a brief description of our prototypes, which engagement area they belong to, and which consumer activity they are meant to influence. Gardening is not addressed by the digital tool, since we maintain that more traditional marketing tools are more suited for this activity.

The prototypes were presented to SITRA as components that could be combined with each other, providing a foundation on which the “Nature & Everyday Life” team could ground different consumption behavioural change campaigns.

## Conclusion

After initial broad research, it became clear that biodiversity marketing is complex and scattered. On the biodiversity impacts side, it is noticeable that the impacts are wide and often there

is no clear link for consumers to easily understand. On the marketing side, many biodiversity campaigns were found, but they were scattered, difficult to find, and often information-based with no tools to actively tackle behaviour change.

With SITRA commencing their project on biodiversity communication to Finnish citizens, we recommended that they address two issues: complexities and scatteredness. With our suggestion of the digital tool, we demonstrated how SITRA can plan their communication campaign. Nonetheless, it is important to point out that each prototype of the digital tool can be viewed as a puzzle piece and is flexible in implementation and content. By offering the Knowledge Library as a backbone of information, SITRA can start building their campaign with these puzzle pieces and refine or add functions according to project needs.

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## Appendix: The Twelve Prototypes

Prototype	Description	Engagement Area	Consumer Activity
<b>QR Code</b>	QR codes at grocery stores would enable citizens to access the knowledge library.	Information & Behaviour	Diet
<b>Personality Test</b>	Recommendations of biodiversity benefitting actions can be tailored according to a user's consumer profile after taking the test. A Finnish animal avatar represents each profile.	Information & Emotional Engagement	All
<b>Sharing Function</b>	After any interactive activity is completed, a screen will pop up, congratulating users and suggesting they share their goal on social media.	Emotional Engagement	All
<b>Kahru Turo</b>	Bear shaped mascot that appears in the notifications users receive, congratulating users for carrying out a task. It can be activated by proximity with certain offers.	Emotional Engagement	All
<b>Circular Shop Map</b>	A map to help citizens to navigate the variety of circular shopping options in Finland.	Information	Clothing
<b>Games &amp; Quizzes</b>	Games on the tool could provide information on biodiversity. Quizzes engage, offer information, and work as surveys for SITRA.	Information & Emotional Engagement	All
<b>Commitment Pack</b>	This prototype allows users to select a team of flagship species, representing different sets of impacts on biodiversity. Users gain points for actions reducing these impacts.	Behaviour & Emotional Engagement	All
<b>Coupons</b>	Coupons for biodiversity-friendly product choices.	Behaviour	Diet & Clothing
<b>X-piring</b>	A digital notebook to keep track of spoilage dates of bought food products. In case of leftovers or homemade products, the list will show the date of making.	Behaviour	Food Waste
<b>Point System</b>	A list of activities users can do to gain points. Points could be used to unlock coupons, outfits for the mascot, etc.	Behaviour & Emotional Engagement	All
<b>SITRA Kids</b>	SITRA Kids is a parallel platform tailored to fit the juvenile audience. It includes materials for educators.	All	All
<b>Grown in Finland</b>	Designed to attract Headstrong Traditionalists and similar	Information	Diet

# VINHOS DE ALENTEJO

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**Does It Pay Off to Be Green?**





*From left to right: Ekaterina, Line, Maarten and Lauren*

## Acknowledgements

First of all, we would like to thank the IIIIEE for organising the SSC course, providing the students of EMP with the amazing opportunity to apply our knowledge and build a bridge between academia and industry.

We would like to thank our client CVRA and its sustainability manager João Barroso, who gave us the opportunity to work on an interesting project, provided us with stakeholder interviews and supported us with great feedback throughout the process. Moreover, we would like to express our gratitude towards all of our interviewees who have met us with great hospitality, enthusiasm and knowledge.

Finally, we would like to thank our supervisor Åke, who throughout this project has been a great facilitator with our client, provided us with support, insights and valuable feedback.

## The team

**Lauren Brach** is from Canada and holds a Bachelor of Business Administration

and Agriculture. She is keen to contribute to the regeneration of the planet's agricultural land. She has leveraged her four years of experience in agricultural supply chains including her most recent role in regenerative agriculture for this project.

**Line Lobedanz** is from Denmark and holds a bachelor's in business administration and Project Management. She is interested in the sustainable transformation of global food systems, benefiting both the environment and human health.

**Maarten Magielse** was born in the Netherlands and holds an undergraduate degree in Commerce from the University of Auckland. Maarten aims to start a farm in an African community.

**Ekaterina Pikuleva** is from Russia and holds a specialist degree in Economics and Management. She has 8+ years of working experience in strategy consulting and impact investing. Now she is focusing on projects in sustainable supply chain management.

# Does It Pay Off To Be Green?

## Economic Benefits of the WASP Scheme

*By Ekaterina Pikuleva, Lauren Brach, Line Lobedanz Witthøfft, Maarten Magielse*

### Introduction

The wine industry in Portugal is facing serious environmental, social and economic challenges. Frequent droughts, decreasing soil quality, employment retaining issues and increasing energy and resource prices are among some of the sustainability challenges that the wine producers of Alentejo are facing. Different measures are taken to mitigate and adapt to these challenges, including certification schemes that holistically address the issue of sustainability. These schemes promote sustainability measures such as regenerative agriculture practices, material

efficiency, energy and water savings to reduce the industry's negative impact on the environment. Understanding the environmental benefits these measures might yield can be a complex and ambiguous process because of the many synergies and long timeframes. As such, it can be challenging for the industry to understand what operational and economic benefits, these sustainability measures directly (or indirectly) yield for them and what barriers there are to achieve them. Thus, understanding what costs there are associated with participating in a sustainability scheme and what cost-savings and benefits this might yield is important to strengthen the business case for sustainable wine production. In other words: *does it pay off to be green?*

### *The Aim of the Project*

In the food and wine producing region of Alentejo (Portugal), the voluntary sustainable wine certification program WASP (Wines of Alentejo Sustainability Program) was launched in 2015 by Alentejo Regional Winegrowing Commission (CVRA). Now the time has come to start evaluating the effects of participating in the



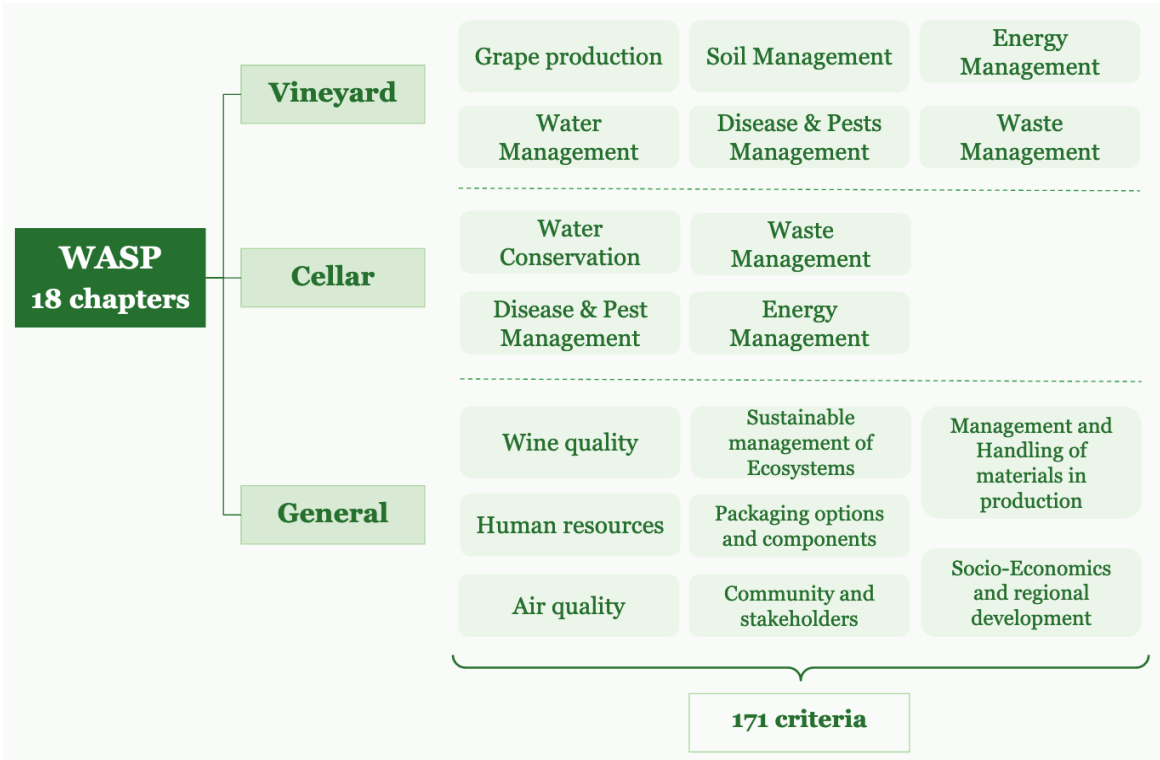
*The vineyard of one of the interviewed members, shortly after the harvest season*

scheme. Thus, our client CVRA and their sustainability manager João Barroso have given us the task to understand if the WASP scheme and its measures result in economic benefits for the members through cost savings or market benefits. The aim of this project is to collect experiences and evidence from current members of such benefits as well as the cost and efforts required to achieve such, to identify potential patterns of cost savings. Moreover, the evidence should serve as a starting point to create a long-term tracking system to monitor and detect these benefits. The goal is to utilise this data to create; 1) a better understanding of the economic benefits for current WASP members, and to; 2) act as a business case for new members.

**What is WASP?**

The WASP certification scheme is a holistic sustainability scheme intended to support

the improvement of the environmental, social and economic performance of Alentejo’s wine making activities. The voluntary scheme has 560 members, of which 11 are currently certified. Members include both grape growers and wineries. The scheme consists of 18 ‘chapters’ with in total of 171 criteria. Each criterion has 4 levels of performance; Pre-Initial, Initial, Intermediate and Developed. Self-assessments are carried out to determine what level one is on, estimated by a point scale of 1,0-4,0, continuously enabling improvement in all criteria. Once a member has reached an eligibility point (3,5 out of 4,0) certification is possible by an accredited third party certification body [1]. The areas of intervention through the 18 chapters have a broad range and holistic view on sustainability (see figure below).



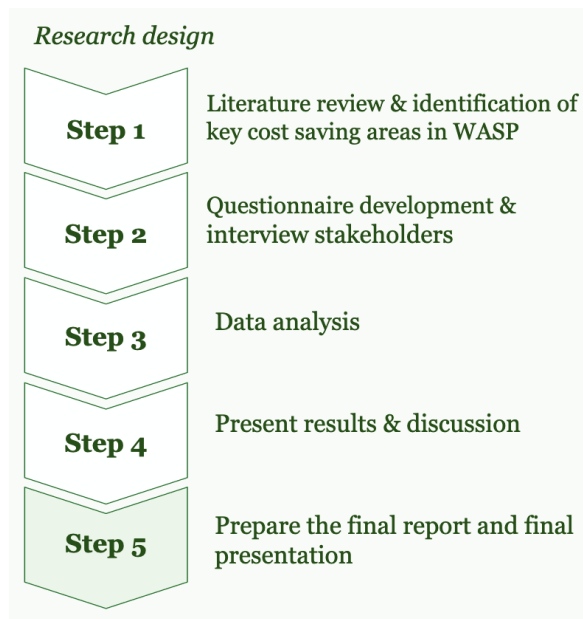
The 18 chapters, providing a holistic view on sustainability



## Research design

### Method

Our methods for data collection in light of sustainable benefits have been two-pronged. Firstly, we drew on secondary data for the purpose of review, through which we looked for the most common benefits and cost-savings of sustainable winemaking. This gave us a clear picture of what areas and practices to focus on for our primary data collection. Through this literature review, we managed to isolate some of the common cost-saving methods and used these to build our interview guide. Our second and most important method for data collection has been interviews we conducted with producers and other stakeholders, through which we collected information on a variety of topics within the realm of cost-savings. After compiling and analysing the qualitative information and quantitative data from the interviews, we were able to find similarities and patterns, which allowed us to provide our client with relevant and reliable information.



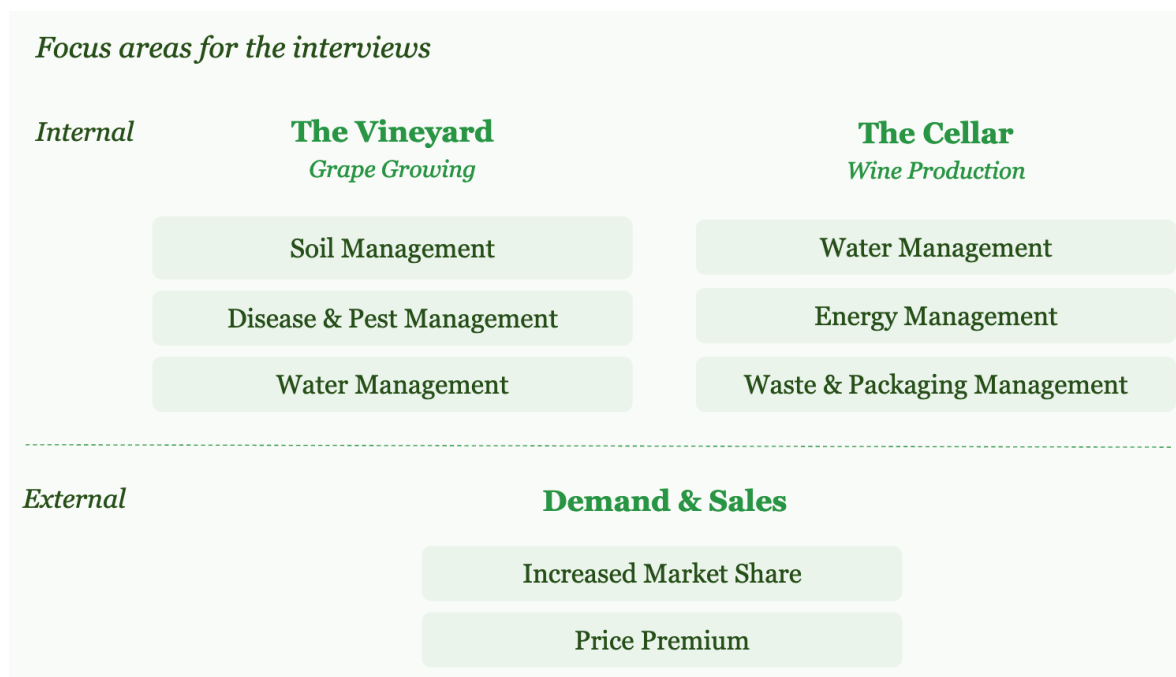
*The research design in 5 steps*

### Literature Review

We reviewed more than 15 research papers with relevant evaluations of sustainability measures in the wine industry.

These are the most interesting results:

- Study of 15 wineries in California showed that for most of the wine production activities producers see that benefits are greater than costs. Also, the study concludes that internal motivations are bigger than external [2];
- “older participants in the scheme (over 5 years), firms with higher export share (>40% of annual turnover) and cooperative wineries tend to be keener to assign a positive evaluation to the benefits/costs ratio in both the vineyard and the winery” [3];
- Consumers that have an orientation towards environmental-friendly products demonstrate “a better willingness to buy organic wine and are more likely to pay higher price premium” [4];
- There are three types of economic benefits of sustainability measures: “reduced input costs, improvements to winegrape quality and vineyard health, and easier compliance with environmental regulations”. Main cost and environmentally effective practices are: precise spraying of pesticides, computer models for disease forecasting and irrigation management [5];
- Case of cost savings: the integration of sheep into vineyards led to reduced mowing and herbicide use. “On average, farmers reported 1.3 fewer herbicide applications



annually, saving US\$56 per hectare and 2.2 fewer mows annually saving US\$64 per hectare” [6].

Overall, the literature review and study of the WASP scheme allowed us to identify the main internal and external areas with potential benefits and build the questionnaire based on these findings.

### *Interviews*

To collect sufficient data, we have conducted on-site and online interviews with 15 different stakeholders. Seven of our interviewees were certified wineries and growers, six interviewees were non-certified wineries and growers, while the remaining two interviewees were regional consultants. Interviewed producers represent the most advanced members of WASP in terms of the implementation progress of sustainability measures.

An interview guide was made for the purpose of providing structure and keeping the interviews uniform, with the aim of receiving answers that were comparable and quantifiable in nature. For this purpose, we chose to subdivide the interview into

three different realms, which were the vineyard, the cellar, and demand/sales (see figure above).

Our main goal during interviews was to obtain information regarding the benefits of the sustainability measures. The information and data from interviews were analysed to find commonalities, through which we derived conclusions on the cost-saving character of sustainability measures and the WASP-scheme.

### *Data Analysis*

We extracted data on implemented measures, cost of measures, observed outcomes and examples of savings and opinions from all interviews. These results represent the best practices that have been developed in the region so far. All measures were grouped into categories with the same outcomes, where possible the examples of quantifications of outcomes were provided. One of the limitations of the analysis was low number of quantitative data provided and its incompatibility (different or not specified period of evaluations, scope, methods, etc.) and thus the inability to

perform the quantitative analysis. As the main goal of the project was to collect information backed with available quantitative data, the numbers in the section below represent the most significant testimonials. Testimonials about indicators of economic benefits and challenges to calculate them were used in the development of the cost-tracking system.

All results were presented in the client workshop and the final report was developed with respect to the feedback from the workshop.

### Internal Economic Benefits

The results are a summary of the most common practices and economic benefits based on the findings of the interviews. For the purpose of this report, we have distinguished two categories of results; informed evaluations and informed quantifications. Evaluations refer to qualitative information that is based on educated observations made by the interviewee. Quantification refers to evidence in the form of the quantity of resources saved or amount of money saved with a clear causal link to the intervention. The economic benefits in the vineyard were documented mostly as informed evaluations as it was difficult for producers to explicitly confirm that the benefits are as a direct result of a certain practice. This is due to the complexities of working with nature with extreme and unpredictable weather events and the multiple outcomes of one measure taken. For example, the use of cover crops can lead to improved soil health, increased biodiversity, and improved disease resilience. However, it is difficult to prove that these benefits are a direct result of using cover crops. The economic benefits of the cellar were

documented mostly as informed quantifications as this was easier to understand the cause-effect relationship.

### Vineyard

In terms of *soil, pest and disease management*, the most important sustainable agricultural practices were the use of cover crops, using a variety of plants to build a diverse ecosystem (e.g. viti forestry, buffer strips), low intervention practices (e.g. no tillage), and (sometimes mentioned) organic and biodynamic farming practices. These practices generally led to improved soil quality, increased or higher quality yield, improved resilience, and reduced resource use.

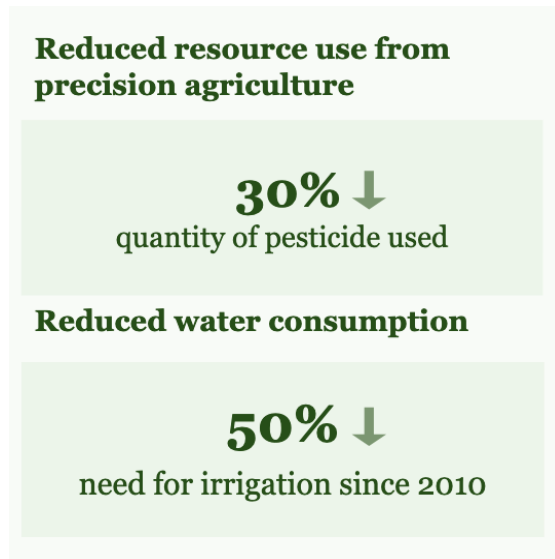


*Some quantifications of internal economic benefits*

In terms of *water management*, the most important practices were irrigation water management such as the monitoring of soil moisture, using flow sensors and planting cover crops. These practices generally led to



reduced water consumption, improved water holding capacity of the soil, and improved plant health and resilience.

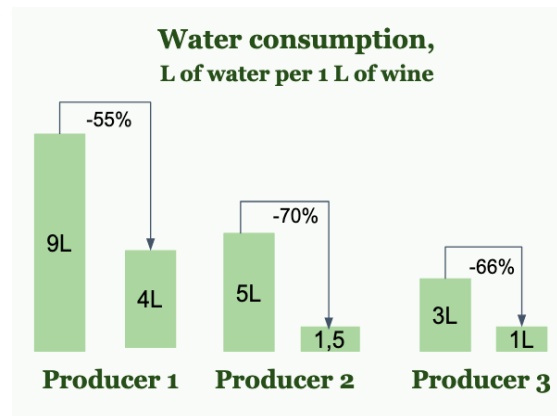


The presented figures are informed quantifications of results from growers that have implemented sustainable viticulture on their land. The results are testimonials of best practices and are not overall results from all interviewees but rather show results that individual interviewees calculated through the grower’s own internal measurement and monitoring systems.

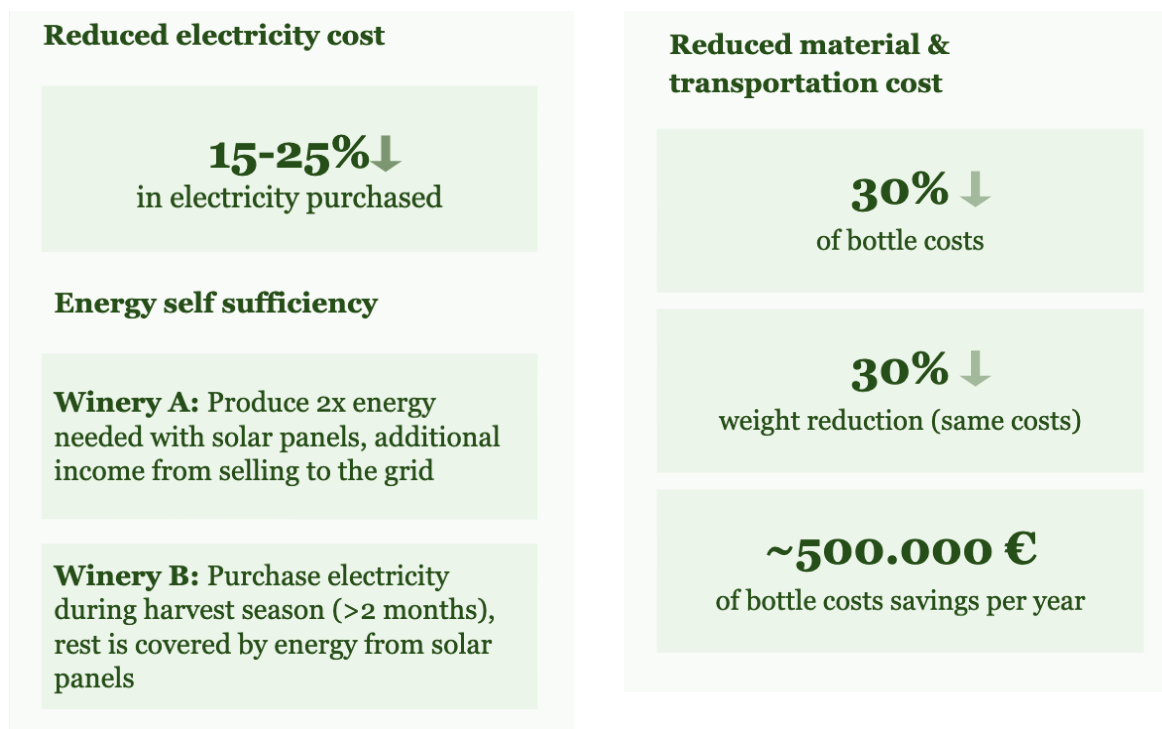
### Cellar

In terms of *water management*, the most important practices were measurement and monitoring (e.g. flow metres), awareness and education, standardisation (e.g. standard operating procedures), and process optimization (e.g. spray nozzles to hoses). These practices generally led to reduced water consumption and reduced costs for wastewater treatment. The main indicator was the number of litres of water used to produce 1 litre of wine. Through these practices, we had five testimonials documenting a 50% to 70% reduction in

water consumption per 1 litre of wine, some of them are shown in the figure below.



In terms of *energy management*, the most important practices were monitoring (e.g. energy metres), using energy efficient equipment (e.g. LED lights), energy efficient construction, and using renewable energy sources (e.g. solar panels). These practices generally led to reduced energy consumption, a 15-25% reduction in electricity costs, and energy self-sufficiency. One testimonial expressed that their solar energy supply was two times what they needed, generating additional income from being able to sell to the grid. Another testimonial documented that they only needed to purchase electricity during their two month long harvest season as the rest was covered by the energy generated by their solar panels. In general, the payback period for solar panels installed was three to five years. Some of these results are shown in the figure below.



In terms of *waste and packaging management*, the most important practices were reducing the weight of the bottles, using sustainable materials for packaging (e.g. FSC certified cardboard), and circularity of waste from wine production (e.g. using stems and seeds for livestock feed). These practices generally led to reduced material & transportation costs. Some testimonials documented a 30% reduction in bottle costs from switching to lighter bottles. Another noted that this led to a savings of 7 cents per bottle. We calculated their yearly savings by multiplying the savings per bottle by their annual production volume resulting in an annual saving of ~500.000 EUR. Other economic benefits include reduced waste collection and treatment costs, and reduced amount of purchased fertiliser. Some results are shown in the following figure.

To conclude on the economic benefits for vineyards and wine cellars, the aforementioned data suggests that there are

possible economic benefits from being a WASP member or certified, yet these benefits are highly dependent on the yearly growing conditions and the energy, water and packaging costs. The following section wishes to highlight the external market benefits of the WASP scheme.

## External Market Benefits

External market benefits were also detected throughout the interviews. These include increased market share, new consumer segments, novel market opportunities and as well as increase in price. All benefits will be outlined below.

### *New Consumer Segments & New Markets*

Firstly, an economic benefit derived from the interviews as a result of participating in the WASP scheme and/or being certified, was increased access to new consumer segments. Many wine producers expressed how they have received increased interest because of the WASP scheme. Some

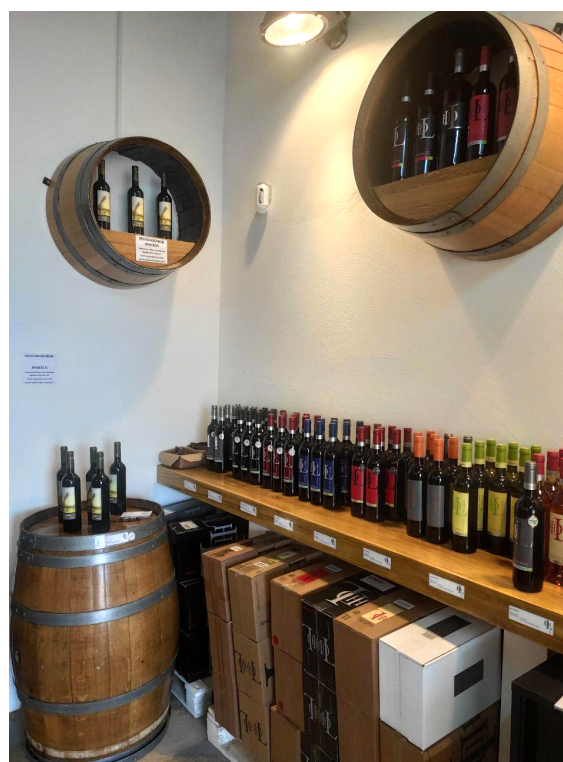
indicated an increase in sales in new customer segments as a result of the certification. An example is a winemaker who experienced increased sales to restaurants in Portugal because of its sustainability efforts. Moreover, the collected data indicated an increased interest from new markets, mainly the UK, Nordics, and Switzerland. These markets share the maturity in terms of sustainability awareness and have customers that have a higher willingness to pay for sustainable or organic products. Thus, the wine producers with an intention to explore these markets, are likely to experience an economic benefit from participating in the WASP scheme and/or being certified. One wine producer indicated increased interest and sales in the UK, whereas another described how their sales in Sweden (Systembolaget) was not possible without the WASP certification. On the other hand, several wine producers indicated no external market benefits as their main markets were Portugal and Brazil where the demand for sustainable wine is much lower.

### *Price Premium*

The second area of benefits derived from the interviews was a potential price premium for wine producers. Two areas of price increases were detected; firstly it was seen how cooperatives or wineries have implemented a price premium for sustainable grapes bought from grape growers. The intention is to incentivise the independent growers to implement sustainability measures by paying a price premium that will cover their investment cost. An example is a cooperative who pays a 10% price premium to all certified vineyards and grape growers. The second type of price premium experienced in the interviews was a price premium for the sales

of wine by wineries. This benefit was not as clear as the rest of the market benefits, as wine producers expressed how their prices are already adapted to their current consumer & market segments. Nonetheless, one producer explained that they will receive a price premium for wine sold in bulk. This is due to the demand from some wineries who have not implemented sustainability measures in their production, but wish to sell certified wine.

To conclude on the benefits seen in the external market, it can be evaluated that there are possible economic benefits from being a WASP member or being certified, yet these benefits are highly dependent on the producers current price, market and consumer segment.



*Store selection of a winery*



## Barriers to Change

Interviews with producers also showed several significant barriers for the implementation of sustainability measures and receiving benefits from them. Some of the barriers included:

- Perception that significant changes in practices should be done.

Some producers see that WASP includes more than 170 criteria they need to meet, and some required practices are not introduced yet. As a result, they can be overwhelmed with the need to change their way of working in many ways, and are resistant to these changes.

- Perception that significant investments are needed.

Similar situation is seen in terms of investments needed. Some improvements will demand new machinery and systems, and investments can be rather large.

- Lack of human resources.

Some testimonials stated that many producers do not have enough time or people to implement changes. The certification process itself may demand more than a month of work to collect evidence of meeting all the requirements of WASP.

- Low willingness to change mindsets.

There are many people of age 50+ involved in the wine production, especially farmers, field workers, etc. They are used to doing the work as previous generations did and they used to do, and are resistant to change their mindset and way of working.

- Long time between investments and the results.

Some areas of improvements like increasing soil fertility, biodiversity, disease management, etc. have long time-frames between initial investments and cost-saving results. For example, changes in soil quality often only occur after 10-30 years. In many cases there was an educated guess that there is positive progress and the actual results can be measured only in the long term. Also, external factors such as changing weather conditions make the progress non-linear and do not allow them to see clear results.

- No tracking system to evaluate the costs and benefits.

For many interviewed producers it was difficult to show cost savings as they do not have measurement systems in place. They monitor specific indicators like water and electricity consumption but they do not measure the effects of the other implemented measures.



## Cost Tracking System

While conducting the interviews, it was conveyed that many of the interviewed winemakers are currently not documenting sustainability measures and resource usage on a yearly basis in all categories. This has led to a situation in which data regarding the effectiveness of sustainability measures is missing. This data is important for tracking the cost savings or extra expenditures that accompany certain sustainable measures conducted in relation to the WASP scheme.

Data collection methodology could be quintessential and symbiotic for both WASP-scheme and wineries. The wineries can use the measurements of the data to gauge which of their sustainability measures are cost-saving, or potentially lead to quality increases. For CVRA, this data could lead to more quantitative insights on cost-savings which can be used in conversations with potential new members to provide clear-cut evidence of the effectiveness of sustainable measures.

This collected data can be used to form trends, which can be visualised through tables and graphs. When engaged in conversation with potential new members, visualised data can be a powerful tool to show potential new members how WASP-measures can influence resource use, proving cost savings from certified members. We have developed a cost tracking system where the answers will be uniform in character, so that they can be compared to each other, through which averages can be made and analyses can be conducted. The final proposal includes five to six questions to be asked to each vineyard and cellar every year.

## Reflections

### *Differences in Results*

There are clear differences between outcomes for the two main areas of implementation of sustainability improvements: vineyard and cellar.

For the vineyard, increased yield and better grape quality are the main outcomes expected by the growers along with stability and predictability of the yield. It was hard to define and quantify the direct outcome of each implemented measure, but together they lead to the increased yield with the same or better quality of grapes as is claimed by most growers.

For the cellar, cost savings are the main indicator of sustainability activities. It is relatively easy to see the cost savings as there is a direct outcome from implemented measures and methods to calculate the economic benefits are usually clear.



*Integration of sheep on vineyards can lead to cost-savings*

### *Measuring: The Key to Change*

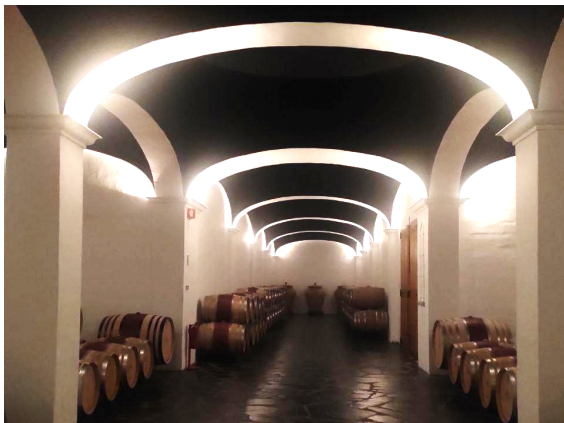
Most of the interviewed stakeholders emphasised that the first step on the sustainability journey is measuring. Understanding the current situation and identifying hot spots in all areas - from soil quality to energy use in the cellar - enables producers to see the abnormalities and losses and to understand what can be improved.

### *Starting with Small Investments*

Sustainability improvements require investments but they are not as large as some producers believe.

There are small measures that are easy and inexpensive to implement that lead to big impacts and savings (e.g. LED lights, water pressure control, sensors, standardisation of operations, etc.), but measurements should be performed on a regular basis and changes tracked and analysed to calculate these savings. For example, sensors and measuring equipment only have a payback period of around one year, as some of the producers stated.

At the same time, for some expensive measures like solar panels, energy efficient equipment, water efficient irrigation systems and others there are available



*Wine cellar of a winery*

subsidies that can cover 30-40% of the investment made. As an example, the payback period for solar panels with subsidies is three to five years and can be even two years with the 2022 electricity prices.

### *No Sustainability Without People*

Social sustainability was the most commonly mentioned area of sustainability that was out of the scope in the initial questionnaire.

Many producers emphasised the importance of taking measures to retain employees. There is a negative trend in the job market in the Alentejo region that it has already been hard to find employees as young people are leaving the region. Additionally, it is hard to find year-round employees for work on the vineyard, especially during harvest season. The stakeholders expect that this problem will only grow in the future. To minimise the risks of a labour shortage, producers implement different measures to create a happy and comfortable working environment, increase wages, and invest in local communities.

Another important observation is that there are no sustainability improvements that do not involve people. Knowledge sharing, acceptance of new practices among workers and their education are crucial in implementing changes both in the vineyard and cellar.

### *Will It Work?*

Not all producers were able to provide the quantitative data on the benefits or have the same opinions about the success of the benefits. For some producers, investments in sustainability are not paid yet and they see mainly costs, not benefits.



There are some differences in testimonials about the results of the same measures among producers. The most questionable areas of cost savings are lighter bottles, increased labor costs for organic practices versus conventional, investments in expensive machinery where the actual benefits depend on many factors like management, negotiation power, market situation, availability of the resources, etc.

Still, even with challenges, barriers and uncertainty, many producers see investments in sustainability as necessary conditions for their long-term success.

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### List of people interviewed

Luis Patrao, Coelheiros, General Manager & Winemaker

Mafalda Vasques, Herdade dos Grous, Winemaker

Alexandre Relvas, Casa Relvas, CEO

Catarina Viera, Rocim, Owner

Helena Manuel, Herdade dos Lagos, Viticulture Manager

Joaquim Vilhena, Winegrower

Jose Luis Moreira da Silva, Esporao, Chief Production Officer

Rita Nabeiro & Ines Luz, Adega Mayor, CEO & Production Manager

Rui Veladas, Carmim, Winemaker

Pedro Baptista, Cartuxa, Winemaker

Hamilton Reis, Mouchão, Winemaker

Luis Gaspar & Helena Ferreira, AC Borba, Winemaker and Vineyard Manager

Luis Mira, Herdade das Servas, Director

Alexandre Alves & Hugo Pardal, Ateva, Technicians

Pedro Tereso, Projeto Agrosustentável, Consultant



*Wine bottles come in many different sizes*



## **Overcoming Barriers to Material Reuse in Nordic Construction Industries**



*Shane, Cecep, Laura and Emma*

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We also wish to thank all stakeholders that give us their time for conducting interviews and participating in the workshops. Finally, we want to thank all the wonderful colleagues from Batch 28 of our master's programme, who have provided invaluable suggestions and comments throughout the project.

## **Team Introduction**

**Laura Redmond** | Hi! I am Laura, from Canada. I have a background in natural sciences and I hold a MSc in biology. I am

specialized in technical and policy-based work around water quality but I have a keen interest in building a circular economy to reduce the impacts on natural environments. I am passionate about the circularity of resources and waste streams, and I see large industries (such as construction) as agents for transformational change.

**Cecep Hermawan** | Hello, my name is Cecep from Indonesia. I hold a bachelor degree in International Relations and Chartered Financial Analyst Level 1. I have 3 years management consulting experience and 1 year environmental consulting experience. I have a major interest in sustainable business and resource-efficient management.

**Shane Yuhasse** | Hi everyone; Shane from the United States here. I am a packaging engineer by trade and have a research interest in the design and implementation of reusable packaging systems. My mission is to make resource-efficient transport packaging accessible to every organization, and platforms similar to Material Mapper will play a central part in achieving this.



# Overcoming Barriers to Material Reuse in Nordic Construction Industries

## A Business Model Improvement for Material Mapper A/S

*Cecep Hermawan, Laura Redmond, Shane Yuhasse*

### Introduction

The construction industry is a major contributor to waste generation and global GHG emissions. From the emissions perspective, 8% of global GHG emissions come from concrete alone (Lehne & Preston, 2018). In 2020, 37% of waste generation in the EU came from the construction industry (Eurostat, 2020). Circular construction and the reuse of materials can reduce waste and emissions from the industry with major impacts.

The need for material reuse has been significantly recognized at the EU level since the early 2010s with the development of the EU Raw Material Initiatives. This also incorporates the target of recovery and recycling of Construction and Demolition Waste (CDW) across Europe. Since then, on the global level, the UN Agenda 2030 was developed in 2015. The EU also agreed on the EU Green New Deal in 2019 followed by EU Taxonomy in 2020. The EU Green Deal (2020) requires 70% of building materials to be repurposed, signifying a push factor from policies to improve green construction practices.

The direction for a circular construction sector follows two principles: (1) Life cycle assessment of the building from construction to demolition, and (2) The circular economy perspective in the material cycle. The Nordic countries in this

context have a rather advanced position, with relatively ambitious and increasing targets set by their governments.

Norway is one of the leading countries in Europe when it comes to ambitions for circular construction, with evidence that municipalities have even more stringent regulations than their national benchmarks. Despite the traditional mindsets still lingering in the industry, acceptance from industry players is higher in the Nordic countries, making it easier for business providers of circular construction services to thrive in the region. Many new businesses are emerging to accelerate this transition.

Our team is helping Material Mapper, a Norwegian start-up providing digital services which facilitate the reuse of construction materials, better understand the circular construction environment in the Nordics to scale their platform and increase its contribution to circularity. We have been working to uncover the barriers of circular construction in the Nordics through desktop research and interviews, which culminated in a workshop which facilitated a robust discussion about strategies for overcoming these barriers together. We brought together major partners and potential partners in the construction industry to create connections towards transformative change.

## Client Overview: Material Mapper A/S

### Fact Sheet:

- Founded in 2020
- Funded for pre-seed investment in April 2022
- Offering: Comprehensive information solution for the exchange of material and masses within the construction industry
- Goal: Be the digital infrastructure for circular construction

The client manages a digital platform which uses artificial intelligence tools to aggregate and organize public records on constructions, renovations, and demolitions; generate estimated inventories of materials contained within buildings; and geo-reference these inventories of materials. All users of the platform can view maps of ongoing construction, demolition and renovation projects and estimates of available materials by location. Users with a paid subscription may use the platform to initiate chats with property owners and access supporting documentation generated in compliance with applicable building codes. The service is currently offered throughout Norway.

Other platforms for the exchange of construction material exist, though these alternatives follow a business model which requires users to manually list materials on a virtual marketplace from which the platform extracts a commission. Such an approach is labour-intensive on the part of the user and has failed to reach a scale which generates adequate information about flows of secondary material to be valuable to the individual user. This limitation is addressed by the client's

unique approach to data collection and aggregation.

Material Mapper's approach of scraping public and private records to create a comprehensive, geographically referenced database of construction material flows eliminates the need for user participation to provide an inventory of available materials. The emphasis of Material Mapper's service is not on enabling a transactional exchange of materials, but rather on revealing local flows of material *en masse* and providing supporting documentation for subsequent material exchanges. This is hypothesised to eliminate barriers to scalability as early users will have greater access to usable information than they would on a traditional marketplace platform. This approach can be categorised as one of a Consumer Innovation Platform (Staub et al., 2021). This means that as a digital infrastructure, Material Mapper's key activity includes partnership management across various service providers. Their digital platform is restricted to subscribers but the interaction is collaborative between users. This archetype of digital platforms has a strong economy of scale where the participation of users and partners can bring flexibility to local contexts. Material Mapper plans to expand into the rest of Scandinavia by 2023 and is currently leveraging partnerships with third party digital service providers to expand the platform's utility including:

- More detailed information about ongoing construction projects
- Automated estimates of emissions impacts from materials and transports. These can be used to certify users' compliance with emissions reduction mandates.

- Inventory routing optimisation tools allowing users to plan exchanges while ensuring minimal transportation costs and emissions.

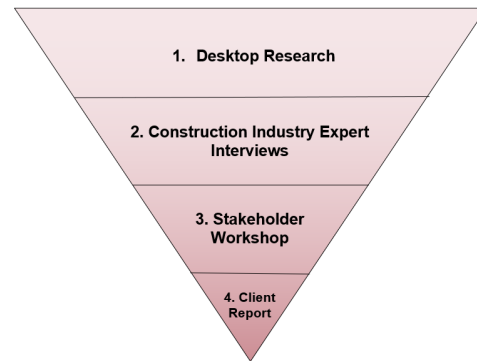
The viability of Material Mapper’s approach depends on them reaching a certain density and distribution of users in a given geographic area. If the client achieves this, their technology could promote more effective value retention for surplus material, encourage the incorporation of more second-hand material into future building designs, and reduce waste and embodied emissions associated with construction materials. With the importance of achieving scale in mind, our approach has focused on two objectives:

1. **Provide holistic and systematic recommendations** for Material Mapper to expand their current business model and create the strongest value proposition to the greatest number of potential users.
2. **Identify external barriers** to the adoption of construction material reuse in the Nordic context and promote collaborations to overcome them.

## Methodology

### *Working Framework*

Our approach is four-level of analysis and engagement aiming to create a holistic approach towards all stakeholders in order to achieve our objectives. Shown by Figure 1, the inverse triangle represents our analysis that sharpened every step of the way to create most direct and appropriate recommendations fit for our client.



*Figure 1. Working framework for the project.*

First, we started with desktop research on policy, the construction industry and client platform, which resulted in the business model canvas and PESTEL and SWOT analysis of the company’s current condition and industry baselines.

Second, we moved beyond and reached out to the industry stakeholders and client’s current customers and conducted interviews with multiple stakeholders, divided into 5 categories: (a) experts; (b) potential customers; (c) current customers; (d) municipalities and (e) clean construction associations. In total, we conducted 10 interviews and received 1 written response to our list of interview questions.

Third, after gathering the insights from the industry, we created and facilitated virtual stakeholder engagement through an interactive workshop aimed to create connections to bridge the gap between barriers and solutions, and create aligned recommendations for the construction industry to act on. The workshop was attended by 10 participants coming from our client company, city networks, construction company as well as the circular economy center, majorly from Norway.

The whole process is made up of reinforcing loops that create rationale behind each recommendation. We employ a multi-level

data analysis process where: (1) we used the desktop research to build client and industry understanding that led us to the creation of interview frameworks; (2) the interview result was coded inductively and the analysis became a background for a stakeholder engagement workshop, and (3) the workshop became a final tool that provided solutions for the client and the industry itself to overcome barriers.

**Scope**

Based on our working process, we narrowed down our analysis into two lenses of focus:

**Networks analysis:** Looked into the construction industry to recommend a strategy for network engagement;

**Policy Scan:** Looked into ways of utilizing new legal requirements as an aspect that can be utilized for business expansion.






Our main deliverables provide two values added. First, they provide a deeper understanding about barriers to reuse in the industry and generate solutions to

overcome it. Second, they provide continuous improvement tools in the form of a feedback form which the client can utilize to gather customer feedback and gradually improve their business model.

**The Nordic Policy Context**

The level of ambition is largely similar across Nordic countries; only timelines and delegations of responsibility vary significantly (Figure 2). For Norway and Denmark, the transformation starts early in 2022 with a year of regulation adaptation process until 2023. Sweden starts soft with a climate declaration requirement for the construction phase only, with an extension to the whole life-cycle planned to be implemented in 2027. Finland is currently reforming its old building code and will incorporate circular construction guidelines and a compulsory carbon limit throughout the building life cycle from 2024. The following table shows each country's plan to implement green building codes.

Figure 2. Level of ambition in green building codes across target markets and life cycle phase

Country [Year of client market entry]	Policy Interventions by Life Cycle Stage (V=voluntary, M=mandatory)			
	Construction	Renovation	Demolition	Material Recycling
 Norway [2020]	<ul style="list-style-type: none"> <li>• Climate assessments [V]</li> <li>• Reuse reports [V]</li> </ul>		→	Measures become mandatory in 2023
 Sweden [2022]	<ul style="list-style-type: none"> <li>• Climate declarations [M]</li> </ul>		→	Incorporation into national building code in 2027
 Denmark [2022]	<ul style="list-style-type: none"> <li>• Climate assessments [V]</li> <li>• Carbon limits [V]</li> </ul>		→	Measures become mandatory in 2023
 Finland [2022]	<ul style="list-style-type: none"> <li>• Climate assessments [M]</li> <li>• Carbon limits [M]</li> </ul>		→	Incorporation into national building code in 2024
 European Union [2023-2024]	Life cycle assessment at all stages supported by EU Taxonomy and other directives. Implementation varies among Member States.			



In addition to different levels of ambition, the policies tackle different degrees of detail and requirements. The main principle is the life cycle perspective of the buildings, where generally all the building codes mandate the construction company, the building management and demolishers to work together to minimise the carbon footprint from the buildings throughout its life cycle.

Denmark and Finland (according to the current bill) have stringent regulations on a carbon limit from the building life cycle, while Sweden still plays on the regulatory phases where only carbon emissions need to be disclosed without limit set at the moment. Norway, with similar ambition to Denmark, supports material reuse and increases the level of circularity in the industry. Figure 3 shows aspects of new regulation which can allow Material Mapper to provide a service that fits the upcoming regulation in its business expansion throughout the Nordic countries.

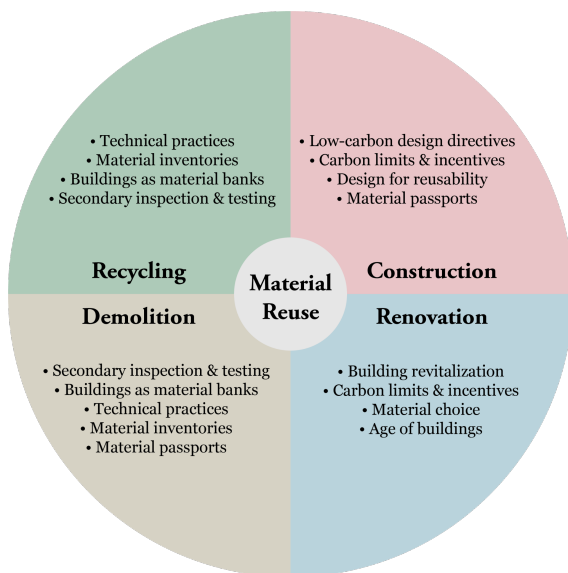


Figure 3. Themes of regulations supporting reuse at each construction life cycle phase.

## Barriers to Material Reuse Across Construction

Through desktop research and interviews with experts in the construction industry, we identified 6 distinct, but overlapping themes (Figure 4) related to the barriers to material reuse and circular construction which aligned well with literature findings (e.g., Knoth et al., 2022). We tested these ideas in the workshop held on 28 October 2022.

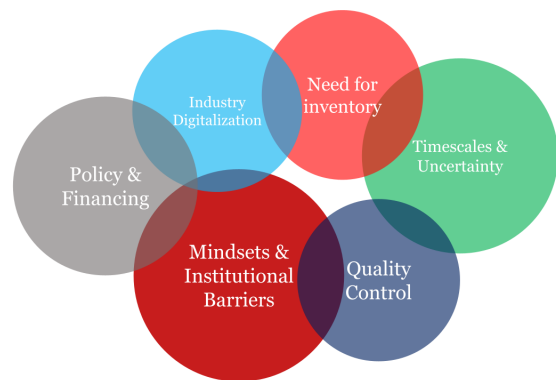


Figure 4. Six major barriers to material reuse in the construction industry.

The first theme was quality control, which includes the lack of standards and certification methods for secondary materials. For example, in Denmark, there is a certification standard for the quality of bricks, which increases confidence and assurance in using second hand materials. However, these standardisations are rare and act as a barrier to reuse. The risk involved in using secondary material is taken by either the seller or purchaser, and makes it a barrier to choosing reuse compared to the guaranteed quality of virgin materials.

The next theme is the lack of physical inventory of reuse materials. There is a high information need to decide on reused materials and this information needs to be

collected and assessed in a timely manner. Users need to know when material will become available, the quantity and quality of materials, where the materials will become available, as well as the logistics behind transportation and storage.

This relates to the theme of timescales and uncertainty. Supply and demand lead times vary greatly and it is difficult to know when exactly materials will be made available or needed. This begs the question of how to store materials or discover mechanisms to align supply and demand.

In the area of digitalisation, different digital tools have emerged to aid in the search and matching of sellers and buyers, however, we heard from experts in the field that the scene is still quite fragmented. Currently, such tools are used predominantly by bigger companies that have the resources to source and reuse materials in this time-consuming manner. There is a need to bring together the tools in a usable way that gives buyers and sellers a one stop shops for planning and logistics.

One of the biggest barriers to material reuse is the traditional mindsets and institutional barriers that exist in the construction industry. It is clear that highly ambitious firms make up the majority of reuse projects in the Nordics, but it is difficult to get laggards on board due to a lack of resources and awareness of the benefits of reuse. The construction industry is very cost-driven and it takes strong motivations for decision-makers to change business models and processes that are so ingrained in construction industry norms and the status quo of business.

Lastly, there exists policies on the EU, national, and local level that can hinder the use of secondary material (e.g., building codes with strict quality control requirements). In addition, financing of these projects can be a barrier because the value of the secondary materials is often quite low and the logistics costs may outweigh the benefits.

## **Overcoming Barriers with Collaborative Solutions**

Although there are multiple barriers to reuse in the construction industry, there are ambitious companies, experts and governments that are striving to overcome these barriers. In recent years, there has been an increase in pioneering pilot projects that aim to drastically raise the bar for reuse in new and refurbished buildings. Long-time experts in the construction industry are seeing the beginnings of transformative change after decades of little progress.

### *Creating the External Environment*

To reinforce the trend in the industry, we also provided recommendations for Material Mapper and other firms seeking to facilitate construction material reuse. Table 1 was developed directly by stakeholders through the workshop. The strategic framework lays out the tools, actors and information requirements to achieve three stakeholder-prioritized solutions to identified barriers. The workshop also encouraged participants to consider what resources they have available to create transformative change in the industry and how they can collaborate to overcome challenges.

Table 1. Resources for Achieving Change for 3 Prioritized Solution

Name of Solution	Tools <i>What are the ideal tools needed to accomplish this goal?</i>	Actors/Network <i>Who needs to be involved?</i>	Information Gaps <i>What information do we need that is missing?</i>	Information Resources <i>What information can my organisation contribute?</i>
<b>1. Digital inventory</b>  (Account of materials in physical storages and within buildings)	<ul style="list-style-type: none"> <li>Material passports</li> <li>Good integration between mapping tools and an open platform with available materials</li> <li>Digital reuse reports</li> <li>AI driven mapping tools</li> </ul>	<ul style="list-style-type: none"> <li>Providers of digital tools related to reuse</li> <li>Architects / advisors</li> <li>Building consultants</li> <li>Construction datahouses</li> <li>Researchers</li> <li>Construction corporates and SMEs, consultants/architects, innovators</li> </ul>	<ul style="list-style-type: none"> <li>Material information - availability, amounts, quality</li> <li>Public access and digitization of inventory</li> <li>Incentives to release information and increase transparency</li> <li>Technology needs</li> </ul>	<ul style="list-style-type: none"> <li>Reuse reports are mandatory in Norway</li> <li>Material Mapper- We provide material availability, quantity estimates, estimates of the different material categories, digitisation of reuse reports</li> </ul>
<b>2. Regulatory requirements</b> to promote the adoption of circular construction and reuse of materials	<ul style="list-style-type: none"> <li>One-stop solutions for policy details</li> <li>Stricter requirements to reduce documentation</li> <li>Assessment tools for standardizations</li> <li>Stipends to incentivise reuse for contractors/builders</li> <li>Flexibility for EPR to shift liability from manufacturer to builder</li> <li>Requirement of reused materials in the structure and/or interior of new builds</li> </ul>	<ul style="list-style-type: none"> <li>EU and local governments + municipalities</li> <li>Representatives from industry - what is practical</li> <li>Policy lobbyists</li> <li>Collective Knowledge Arenas</li> <li>Consumers (need to increase demand for housing with reused materials)</li> </ul>	<ul style="list-style-type: none"> <li>Studies supporting performance standards for secondary material</li> <li>What quality control is necessary for different needs?</li> <li>Studies about CO2 possibilities in reusing materials</li> <li>Quality control of aggregates</li> <li>Lacking awareness from industry for cost concerns</li> </ul>	<ul style="list-style-type: none"> <li>Attendance at events and parliament</li> <li>Access to decision makers</li> </ul>
<b>3. Cross-sector &amp; interdisciplinary collaborations</b>	<ul style="list-style-type: none"> <li>A network of actors</li> <li>Multilevel collaboration platform (from national to local)</li> <li>Workshops for networking and integration of existing programs</li> </ul>	<ul style="list-style-type: none"> <li>Demolishers, construction companies</li> <li>"Boots on the ground"</li> <li>Academia, research institutions</li> <li>Municipalities</li> <li>Knowledge Arenas</li> <li>(Circular construction focused NGOs, consultants etc.)</li> </ul>	<ul style="list-style-type: none"> <li>Who has relevant knowledge from their own day-to-day?</li> <li>Missing key examples and case studies where re-users make their own reporting publicly accessible and digital</li> </ul>	<ul style="list-style-type: none"> <li>Building on symbiotic relationships</li> <li>Material Mapper network</li> <li>PropTech companies with different information across many industries</li> </ul>

### Recommendations

Based on our findings from the above desktop research, expert interviews, and workshop, a set of strategic recommendations for firms seeking to advance reuse of construction materials was developed as seen in Table 2. These guidelines have been written to be generally applicable to diverse actors in various geographic contexts and can be described by the three-part taxonomy to the right. A more tailored set of recommendations and a feedback form geared towards continuous improvement have also been provided to the client.

The understanding that the utility of an entrenched practice of reuse supersedes that of a strong product offering will be critical for success. Norms and regulations

must play a role in establishing practices of reuse so that support systems can become broadly useful.

### Taxonomy of Recommendations

1. **Maximise Value Added**  
Optimise value proposition by improving product utility and catering to customer niches.
2. **Collaborate Externally**  
Invest in capacity development through partnerships outside of established value channels.
3. **Advocate for Policy Change**  
Largely, regulation must be the first domino to fall to enable the possibility of reuse and incentivize the development of reuse markets.

Table 2. Recommended strategies to achieve scale and promote material reuse in construction.

Maximise Value Added	Collaborate Externally	Advocate for Policy Change
<ul style="list-style-type: none"> <li>• Focus on providing utility to <b>Architects</b> to accelerate scale. Architects have an outsize influence on the demand for secondary material. Information value of an aggregated, geo-referenced inventory of available materials is highest during the design phase of a construction project.</li> <li>• <b>Extend timelines</b> for material supply and demand planning. Allow users to schedule and reserve future supply of material.</li> <li>• <b>Government</b> is often the single largest developer at a local scale. Onboarding users within public procurement can jump-start activity in a targeted area.</li> </ul>	<ul style="list-style-type: none"> <li>• Partner with <b>co-operatives</b> to reach <b>small actors</b>, who tend to under-participate on platforms.</li> <li>• Partner with a specialist to generate <b>chains of custody</b> for structural materials. This can mitigate quality concerns.</li> <li>• Investigate the capability of <b>manufacturers</b> to issue warranties for multiple cycles. Encourage them to design products for reusability.</li> <li>• Invest in strengthening ties with <b>environmentally ambitious organizations</b>. These will reach users with the greatest interest in your platform. Be the service they want to promote!</li> </ul>	<ul style="list-style-type: none"> <li>• Revise national <b>building codes</b> in target markets to allow for structural use of secondary material where proven safe.</li> <li>• Develop <b>performance specifications</b> and <b>field inspection</b> techniques for common structural materials.</li> <li>• Mandate the use of digitised <b>material inventories</b> in all new constructions and renovations.</li> <li>• Allocate a portion of embodied emissions in construction materials toward the construction and demolition life cycle phases. Currently, only manufacturers are influenced by carbon pricing.</li> </ul>



## Reflections

Our SSC project has created value for Material Mapper and the green construction movement as a whole. This value aligns well with our original project objectives, as we have successfully:

1. **Provided holistic and systematic recommendations** for Material Mapper to expand their current business model and create the strongest value proposition to the greatest number of potential users.
2. **Identified external barriers** to the adoption of construction material reuse in the Nordic context and promoted collaborations to overcome them.

Table 3 explains the value of our project deliverables in greater detail. Importantly, we have also learned a great deal about the complexities of adapting the business culture of a new wave of “green rush” startups to the counter-accelerationist ideals of true sustainability.

Policy, and the culture which advances it, are both necessary to counteract the operational burdens carried by the large majority of sustainable business models. We hope that readers will recognize that the success of a green startup relies just as much on *creating an environment* conducive to sustainable practices as it does traditional competitiveness. Business leaders must drive this change.

Table 3. Value delivered to the client based on each deliverable

Item	Objective Achieved	Value for Client
Barriers	2	Understanding of the problem in the industry, perspectives from different stakeholders on the current conditions
Policy Scan	1 & 2	Landscape of current and upcoming policy, aspects that can be utilized for business expansion context.
Strategic Planning for Holistic Clean Construction Solutions	2	Creating opportunities for greater collaboration, and guidelines for strategies to overcome barriers in the clean construction environment.
Internal Business Recommendations	1	Business diagnostic and possible business improvement for the company based on the current business model.
Feedback Form	1 & 2	Tool for continuous business improvement and strategic client acquisition - The target audience of the survey will be prospective customers that have been given access to the platform for a limited period of time. The tool will provide Material Mapper with feedback in an organized way which can be used to improve customer acquisition and retention.

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### List of people interviewed

Alastair Carruth, Environmental Consultant at SWECO (2022/10/12)

André Aasrud, Senior Adviser for Clean Construction Programme at C40 Cities (2022/10/19)

Andreas Holmgren, Sustainability Manager at Treano Brygg (written response on 2022/10/27)

Anett Andreassen, NCH Transition Groups Manager at Natural State (2022/10/26)

Anne Sofie Handal Bjelland, Doctoral candidate at Western Norway University of Applied Sciences [Høgskulen på Vestlandet] (2022/10/12)

Christopher Marton, Sustainability Analyst at TomorrowToday SE (2022/10/14)

Daniel Hindman, Associate Professor of Wood Engineering at Virginia Tech (2022/10/17)

Erlend Seilskjær, Architect at FutureBuilt (2022/10/21)

Jill Saunders, Energy and Environmental Advisor at Asplan Viak AS (2022/10/26)

Mathias Peitersen, CIRCuiT Project Employee at Copenhagen Municipality (2022/10/20)

Åke Thidell, Lecturer at The International Institute for Industrial Environmental Economics (2022/10/12)



**Building a Cleaner City**



*From left to right: Adriana, Azusa, Maëlle and Silvia*

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## The Team

**Adriana Fernández**, originally from Costa Rica, studied Chemical Engineering at the University of Costa Rica. She has worked for the Environmental Analysis Laboratory at the university and for the Ministry of Health of Costa Rica. She is passionate about the environment and

thinks that one of the most impactful ways of tackling our global problems is to work at the local level.

**Azusa Lindwall** grew up in Japan and has worked as a management consultant with focus on strategic risks and sustainability, both in Tokyo and Bangkok. She finds it most rewarding when working with people from diverse cultural and professional backgrounds to find common solutions to tackle global and local sustainability issues.

**Maëlle Soulis** was born in France and has done a bachelor's in social Anthropology at the London School of Economics. Maëlle believes in the power of working together with our cultural differences to face the climate crisis. She also trusts that changes at the city level can go a long way.

**Silvia Kim**, from South Korea, holds a bachelor's degree in Business and Commerce. She has experience in carbon trading in Japan. She has a great interest in corporate sustainability efforts and contributions to the local community and society.



# Building a Cleaner City

## A Carbon-Free Utsunomiya - Insights from Swedish Model Cases

By Adriana Fernández, Azusa Lindwall, Maëlle Soulis, Silvia Kim

### Introduction

Urban areas represent only 2% of the world's total land area, yet account for almost three-quarters of humanity's greenhouse gas emissions. Today, decarbonisation agendas call for a need to reimagine the way we build and organise cities. In this context, many cities around the globe have been engaging in carbon neutrality efforts. A zero carbon city, for instance, is one that reduces its carbon footprint through the use of renewable energy sources, the development of energy-efficient infrastructure, promotion of lifestyle changes, and the offsetting of residual emissions. Despite common goals and strategies, there is no one single model for achieving carbon neutrality. Rather, each city has unique characteristics and resources which shape its zero-carbon path, and carbon neutrality strategies must be adapted to the local context. This is the challenge that our team has taken up: to support our client, the Japanese municipality of Utsunomiya, in achieving its goal to become a carbon neutral city by 2050. To support them in that goal, our project strives to:

- 1 Introduce advanced model cases of carbon neutrality strategies and measures adopted by selected benchmark municipalities in Sweden, and

- 2 Make recommendations for Utsunomiya's carbon neutrality plan in a way that is transferable to the context of the city.

### Project Approach

#### Project Steps



Figure 1. Project steps

The project steps are shown in Figure 1. In addition to desktop research and a literature review, our team conducted 12 interviews with experts and professionals including municipality representatives, an energy company, nongovernmental organisations, and academia. In parallel, to understand the current context of our clients' city, we carried out interviews and surveys with representatives of the

municipality of Utsunomiya, academia and students from Utsunomiya University, and local non-profit organisations. The information and data gathered through interviews and desktop research/literature review was organised in a matrix highlighting success factors, challenges/barriers, drivers, key measures, stakeholders, implementation/action processes, thoughts on transferability, and other insights into key projects in the selected benchmark cities for analysis.

### Description of Utsunomiya

Utsunomiya is the prefectural capital of the Tochigi Prefecture in Japan. Below are some of the city's key characteristics relevant to their carbon neutrality plan:

- *Ageing and shrinking population*

The population of Utsunomiya is forecasted to have decreased by 15 000 by 2035, and to further go down by 50 000 by 2050. It is an important aspect to be considered for sustainable urban planning.

- *Geographically dispersed population*

Most inhabitants are clustered around Utsunomiya station while the rest are scattered in a wide area outside of the urban zone, making transport and resource use inefficient.

- *High car dependency as means of transportation*

The proportion of carbon dioxide (CO<sub>2</sub>) emissions from transport is 7% higher in Utsunomiya compared to that of Japan as a whole. The ratio of car use compared to other transport modes (walking, bicycle, and public transport) has indeed increased over time from 57% in 1992 to 69% in 2015.

From client interviews and desktop research, we identified that our client is looking for insights that contribute to the following objectives:

- 1 *Leading Decarbonisation Region* initiative led by Japan's Ministry of Environment, in which municipalities with advanced decarbonisation practices are given additional governmental support;
- 2 Utsunomiya's urban development vision: Networked Compact City;
- 3 Infrastructure improvement and measures to assist behavioural change of both citizens and industries.

### Selected Focus Areas and Benchmark Cities

Based on our pre-study, we narrowed down our analysis scope to three aspects of urban development that we deemed most relevant to its carbon neutrality goals (Figure 2).

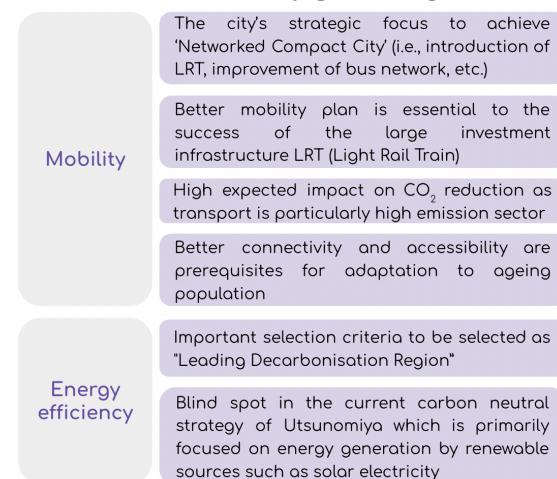


Figure 2. Selected focus areas and rationales

We selected three cities in Sweden as our benchmarks, based on their respective characteristics and similarities to Utsunomiya in terms of socio-economic, demographic, and geographical criteria, as

well as their carbon neutral/urban development strategies.

*Gothenburg:*

- Robust manufacturing sector (e.g., Volvo) similarly to Utsunomiya which has manufacturing sites of large Japanese companies, and most notably R&D centre of Honda in the neighbouring area;
- Model city for the municipality-industry collaboration on the urban development, especially in the area of mobility with Volvo (e.g., testbed for mobility solution)
- Ranked No.1 in the Global Destination Sustainability Index;

*Malmö:*

- Similar urban development strategy to Utsunomiya in its aim of becoming a *Compact City*;
- Advanced solutions and numerous experiments for sustainable mobility management;
- Ranked No.7 in the Global Destination Sustainability Index 2019;

*Lund:*

- Similar to Utsunomiya in terms of neighbourhoods dispersed outside of the central urban area;
- The tramway was introduced in 2020 similarly to Utsunomiya, which plans to open the LRT in 2023.

## **Our Understanding of Utsunomiya Strategy**

### *Zero Carbon City*

As an action plan to support its 2050 carbon-neutrality goal, Utsunomiya has

launched a movement to educate citizens and promote decarbonised lifestyles. The campaign reminds people that their daily activities play a part in CO<sub>2</sub> emissions and, for example, encourages them to consume less plastic and to sort and recycle their waste.

Renewable energy represents another pillar of Utsunomiya's action plan. The city works with a regional energy company to supply municipal facilities and public transportation with electricity from renewable sources. It further plans on expanding solar panel installation since solar has the highest potential among renewable energy sources in Utsunomiya. Yet, the city's efforts regarding solar power primarily focus on electricity, not heat use.

### *Networked Compact City*

Due to a low birth rate and an outflow of the working-age population (15-64) to bigger cities, Utsunomiya's elderly population (+65) is growing while the proportion of its young population (0-14) is declining. The city is concerned about the impact of this demographic trend on the local economy, housing, and social welfare. In response to these threats, Utsunomiya aims to build a Networked Compact City.

A *Networked Compact City* refers to a city with a higher density and where everyone, from children to the elderly, can move around safely and efficiently. As a solution to urban functions being scattered around the city, Utsunomiya designated the city centre and the existing communities in the suburban area as *hubs* that comprise all those urban functions necessary for daily lives. The city has invested in an LRT (Light Rail Transit) system to connect the city centre with each hub. The public

transportation network near LRT stations is currently under development.

## Criteria for Transferability

To assess whether the chosen model cases are applicable to a sufficient extent to Utsunomiya’s context, a set of literature-based criteria was used. These criteria helped to develop the interview guide that was used to understand the transferability of cases to the local context.

Although these cannot prove that the proposed initiatives will be applicable, they provide promising ideas and perspectives on transferability from experts and academia that are valuable when implementing new measures.

*Note limitation:* bias may arise in some of the criteria since the survey was conducted using university students and the perspective of the Utsunomiya municipality employees.

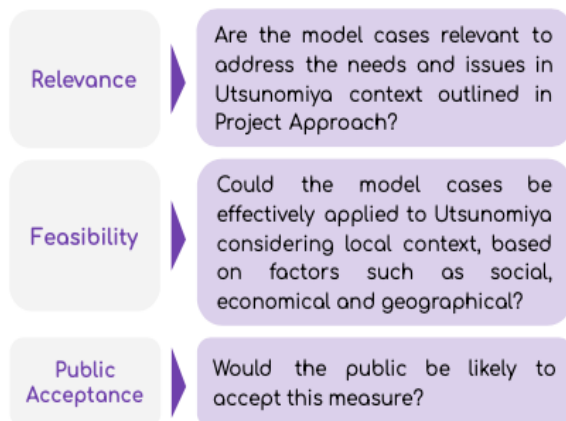


Figure 3. Transferability criteria

## Mobility

### Sustainable Mobility Strategy in Malmö

The city of Malmö has set an ambitious goal to become carbon neutral by 2030. Malmö

has also devised a comprehensive urban development plan with the key strategy to grow by inward expansion to achieve a *close, dense, green mixed-function city*, and eventually become a *Compact City*. Core objectives of this strategy are:

- Reduced consumption of resources;
- Building for proximity (flexibility, multifunctionality, and space efficiency), and;
- Generating a rich and vibrant urban life while sustaining strong elements of greenery.

Malmö defines mobility as an integral pillar of its plan. The city hopes to make *walking, cycling and public transport [...] the first choice for all who work, live or visit in Malmö while reducing the use of cars*. It has set clear distribution targets for each transport mode by 2030, both for inhabitants and commuters.

Achieving these targets requires a mix of approaches, such as building or upgrading roads, transport and building infrastructure, and promoting soft measures to encourage behavioural change (awareness campaigns, etc). The municipality cannot make these changes alone; involving various stakeholders, especially urban developers, is key to transforming the mobility infrastructure and urban design of the city. For developers to align with Malmö's vision, the municipality implemented the following instruments.

*District categorisation with differentiated targets and measures:* The municipality has divided the city into 15 sub-areas based on infrastructural differences as well as conditions of and accessibility to different modes of transport. The targets of transport modes are set for each sub-area and, put



together, these determine the overarching goal to be reached. For example, sub-area 1, a central zone of the city, has a 15% car travel target, whereas sub-area 15, being located in the outskirts and having less public transport available, has a car travel target set at 55%. When they aim to start a project in one of the sub-areas, developers are required to issue proposals on how the project will contribute to achieving the targets and its expected effects (e.g., how much car traffic reduction can be expected, etc.).

*The city administration's technical design manual:* The municipality developed a technical handbook for the city's properties and streets. Developers and other contractors are mandated to follow the guidelines stipulated in the handbook when designing facilities or infrastructure on public land. Principles and guidelines are set for areas including project planning, street construction, parks and green areas, traffic regulation, environment, and so forth. The handbook is publicly available [online](#), ensuring transparency to all stakeholders. With this document, the municipality aims to ensure that their urban development and sustainability strategies are embedded in all development projects.

### *Implementation*

Malmö has developed plans for public transport, cycling, and pedestrians under its urban mobility strategy, aiming to reduce car use while promoting sustainable transport. The cornerstone of the policy has been to combine hard and soft measures. Malmö has implemented a set of infrastructure and has, in parallel, deployed informative initiatives such as a public awareness campaign.

### *Hard measures*

*Bus:* Malmö introduced a bus priority system. Exclusive bus lanes by road markings avoid congestion caused by private vehicles. Green lights are more frequent and last longer for buses. Furthermore, real-time bus arrival information signs were installed at major bus stops. Travellers can also use their mobile phones to track their bus live. Bus priority measures shortened travel time and increased punctuality and service reliability.

*Bicycles on public transport:* Regional buses connecting Malmö with neighbouring areas and Öresund trains connecting Denmark with Sweden allow passengers to bring their bicycles. Regional buses are equipped with bicycle racks on the back so that commuters from other cities can bicycle within Malmö. Train cars offer platform-height floors for cyclists to easily transport their bicycles.

*Cycling infrastructure:* Malmö has built an extensive network of bicycle paths with a total of 515 km and operates a rental bicycle service. Along with bicycle parking spaces placed all over the city, Malmö has opened indoor bicycle parking facilities near the train station to provide a convenient way of commuting, combining public transport with cycling.

Malmö has tested various solutions to make cycling safer and faster. Cyclists can hold on to railings placed at almost every traffic light by resting their arm or foot on them. Radar sensors installed on bicycle lights detect approaching cyclists and quickly turn green.

In public air pump stations, cyclists can easily repair a low or flat tire. Besides, direction signs at intersections and bicycle

street maps guide cyclists to their destinations.



Image 1. Stop rails at traffic light

### Soft measures

*No Ridiculous Car Journeys campaign:* A 2008 survey revealed that a large number of car trips in Malmö were shorter than 5 km, which were thus defined as *ridiculous*. Consequently, Malmö launched the No Ridiculous Car Journeys campaign to encourage people to reflect on their car usage and to use bicycles.

The city used different methods to make the campaign visible to citizens. A billboard was set up on the main square where various events such as concerts or giveaways to reward cyclists were organised, volunteers in orange jumpsuits rode bicycles around the city, wearing bags that said: *I used to be a car driver*. Moreover, an online competition had people confess and share their ridiculous car trips, with the winner being offered a bicycle.

*Cycling barometers:* Located in two areas with high bicycle traffic volumes, barometers with sensors keep count of passing cyclists and display that number on their screen. This tool aims to nudge

citizens by visualising how many are using bicycles and to praise cyclists.

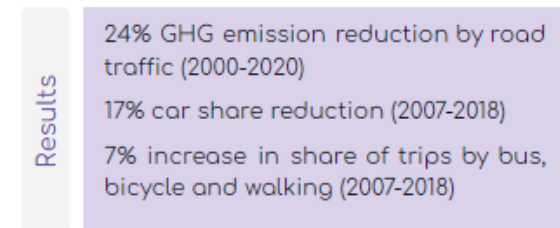


Figure 4. Malmö's achievement

### Success factors

*Collaboration with public transport operators:* Malmö has been working with a regional transport company (Skånetrafiken) to improve operations and services such as a mobile app to track real-time bus information. A joint board formed by the city of Malmö and Skånetrafiken facilitates dialogue and collaboration, resulting in a smoother decision-making process.

*Testing:* Malmö set up two demonstration cycle paths to test innovative ideas and techniques. A route in the city centre focused on car reduction and bicycle/pedestrian increase, whereas the more suburban route, which was notorious for cyclist and pedestrian accidents, prioritised safety and accessibility. Measures with successful outcomes were subsequently implemented throughout the city, resulting in an advanced support system for cyclists.

*High visibility:* Many of the measures employed in the campaign had a very visible character, which enhanced its effectiveness and made it spread to other cities such as Helsingborg, Kristianstad, and Umeå.

*Monitoring and evaluation:* Malmö conducted a survey on travel behaviours to understand citizens' needs for transport and assess the public acceptance of new measures. Continuous monitoring and

evaluation enabled further system improvement by providing data needed for decision-making.

### Barriers

*Maintenance cost:* Not all tested measures were kept afterward due to maintenance costs. The city withdrew certain measures because the actual operation cost exceeded its forecast.

*Continuous dialogue with stakeholder:* Maintaining dialogues with stakeholders represents another challenge. But it is critical, for instance, to educate politicians by sharing knowledge about the impacts of traffic and transport and public opinions from the survey results.

### Transferability

*Relevance:* In Utsunomiya, only 6% of residents take public transport for commuting, while more than 70% use a car. 50% of people drive a car for trips as short as three minutes due to a lack of public transportation services in suburban areas.

Promoting public transport is essential for Utsunomiya, considering its aim to create a compact city, but also to counter the safety risk posed by the elderly driving.

*Feasibility:* Utsunomiya's flat terrain is suitable for cycling. Applying some of the hard measures outlined above is feasible from a cost perspective. For instance, mandating a permanent bus priority lane, and installing sensor radars, leaning bars, and air pump stations are interventions that do not require a big amount of funding. Furthermore, coordination with different departments at the municipality level or the involvement of external stakeholders would likely not be necessary, making implementation less complex.

In contrast, expanding bicycle lane connectivity may necessitate collaboration with stakeholders from different areas and even external stakeholders. It is important to consider that such an intervention might hinder the effectiveness and implementation of the other hard measures discussed here. Therefore, the city must aim to create different collaboration structures and platforms which will be elaborated on in Section 6.

In the same way, setting up a measure for transporting bicycles on buses requires partnering with bus companies. Although feasible, it reduces space on the bus for other users, which poses the question of public reception. To start normalising this change and mitigate negative sentiment, the measure could in a first stage be implemented only during off-peak hours. On the other hand, LRT has space for wheelchairs and baby strollers in the middle. Since bicycles are allowed in the same train car with wheelchairs, baby strollers, and luggage in Malmö, Utsunomiya could consider allowing bicycles to the LRT. Malmö's rules, such as no bicycles during rush hour and prioritising passengers in the packed train, can be a benchmark when investigating feasibility.

Finally, according to our interviewees, there is strong political support coming from the municipal level, and taking into consideration the recent implementation of the LRT and the Carbon Neutral Plan, there seems to be a special focus on the mobility aspect that gives political feasibility to the measures described here.

*Public acceptance:* Utsunomiya citizens' satisfaction with public transportation and the cycling system is 25% and 26%, respectively. This is explained by the

inconvenience and inconsistencies of the bus service and the lack of safe bicycle paths and parking spaces. Further, most students showed support and enthusiasm for practices in Malmö. Some stated that they would cycle to commute if bicycles were allowed on public transport, and others expressed a willingness to change their travel behaviour upon infrastructure development and a better support system for users. Overall, public acceptance seems positive.

## Energy efficiency

### *Linero Pilot Project in Lund*

Linero, a district in eastern Lund, represents a smart city upgrade project that aims at improving around 800 apartments built in the 1970s to create more energy-efficient, eco-friendly housing. Half of the buildings have been retrofitted from 2014 to 2021 as part of a pilot project powered by the EU. It stemmed from the problem that the area had become both unsustainable and unattractive, with buildings increasingly expensive to operate. Accordingly, the renovation aimed to improve thermal comfort in the houses by raising energy standards while maintaining the same monthly rent for the tenants.

Some examples of renovation work that have been performed include the following: light bulbs were changed to LED, a solar photovoltaic system was installed, temperature sensors were set up in each apartment, roofs were insulated, least performing windows were replaced. In addition, a monitoring system was developed, targeting residents' awareness and behavioural change. Mainly, a smartphone app was provided for tenants to visualise and evaluate their energy use

based on real-time and historical data.

### *Success factors*

*Preaching policy (communication actions, awareness raising):* Tenants of all generations were involved in the project both before and all throughout the process. Various workshops and meetings held in the early stages provided an opportunity to acknowledge their needs and ideas. Overall, tenants' engagement not only increased overall satisfaction with the project but also mitigated negative attitudes due to, for example, temporary living inconveniences such as noise and limited accessibility.

*Behavioural instrument:* The smartphone app led to increased awareness among the users and gave them more control over their energy use.

*Preliminary work:* On-site measurements of the buildings were performed to determine existing problems, and tenants were consulted.

*Financing:* The renovation was financed by public money from the EU and the Swedish government.

### *Barriers*

*Transaction costs:* Communication with the community entailed more time and costs.

*Limited funding:* the project only included retrofits that were found most cost-efficient in the projected investment period.

*Legislation:* Renovation projects must comply with national building codes and regulations.

### *Transferability*

*Relevance:* Residential buildings represented 19% of Utsunomiya's CO<sub>2</sub> emissions in 2019. Accordingly, improving energy efficiency on already existing



buildings would be a great way to support the city's carbon neutrality plans. The Linero project covers both infrastructural upgrade and behavioural change, which exactly meets the expectations of our clients. In the Linero renovation, energy conservation has been playing a key role, with much importance given to insulation. Indeed, wall facades and windows largely contribute to energy loss in buildings. Insulation minimises heat loss in winter and retains coolness in summer. Currently, Japan has lower insulation standards than other developed countries with a similar climate: Utsunomiya could lead the way and set an example! In addition to reducing carbon footprint, energy efficiency efforts also lower energy bills for individuals.

*Feasibility:* Insulation measures may be difficult to transfer to Utsunomiya under the current housing condition, dominated by detached houses rather than apartment buildings. However, soft measures such as performance feedback on energy usage and social comparison (competition with neighbours) could be applied even for detached houses. These measures are relatively easy and financially feasible to implement. In the future, the hard measures for energy efficiency may become viable and relevant for Utsunomiya. Indeed, as the elderly population is increasing, this could raise the needs for more dense housing (i.e., apartment buildings) as opposed to having independent detached houses.

### *District Heating and Cooling in Gothenburg*

District heating (DH) is a centralised system that supplies heat to end-users by using local fuel or heat resources that would

otherwise be wasted. The heat is distributed through a network of underground pipes. DH is considered to be an efficient, environmentally friendly, and cost-effective method for heating buildings. In 2011, the Gothenburg power company owned by the municipality reported that its emissions were reduced by 90% during 38 years of system implementation, despite increasing supply.

District cooling (DC) is a technology in which chilled water is generated centrally in large chiller plants and distributed to connected buildings via underground pipes. Internal chillers in individual houses are replaced by a single external source; fewer chillers mean fewer refrigerants, such as hydrofluorocarbons, lower energy consumption, and less CO<sub>2</sub> emissions.

Gothenburg has developed an inexpensive way to do this: using the local river to pre-cool the water. Businesses, offices, hospitals, and industries benefit from DC. The service is offered at a very low price since it uses naturally cool river water. Based on Gothenburg's experience, the use of DC instead of air conditioning units for each building will save on costs and emissions.

#### *Barriers*

*Investments:* Expanding and maintaining the network entails large upfront investments;

*Physical capacity:* Sufficient space is needed for DH/DC facilities (technical components, pipe network installation);

*Technical expertise:* Running the facilities requires technical knowledge and training of civil servants and decision-makers.

#### *Transferability*

*Relevance:* Literature and extensive

experience across Europe have shown that installing DH/DC can substantially reduce emissions, improve air quality and reduce costs of energy. It seems that Utsunomiya has been focusing on electricity generation while neglecting energy efficiency. Yet, businesses and households account respectively for 22% and 19% of CO<sub>2</sub> emissions per year in Utsunomiya. To address this, more ambitious initiatives are needed.

*Feasibility:* The installation of a DH/DC system in Utsunomiya would constitute a long-term project with large investments and coordination by the municipality. However, it would be possible to develop it as a test bed in a location close to the industrial zone. Similar to Gothenburg, Utsunomiya has industrial estates which may have potential for utilising waste heat.

DH/DC is not an unknown system in Japan. Shinjuku, the business district located in Tokyo, has a district heating/cooling system currently in operation. Therefore, from a capacity and expertise perspective, such a project could be feasible.

Unlike Sweden, where the amount of sunlight in winter is very low, Utsunomiya has many sunny days in winter and a large daily temperature difference, making solar heat utilisation suitable, as proposed by students at Utsunomiya University and an interviewed non-profit organisation. In Utsunomiya, where summers are hot, electric air-conditioning is commonly used, which accelerates the heat island effect. According to research conducted by Utsunomiya University and a non-profit organisation, geothermal heat has the potential to cover about half of the total energy demand of the entire city. The use of geothermal heat pumps, which have a high efficiency, is a feasible idea to explore

further. Although it is difficult to build large-scale DH/DC infrastructures in existing residential areas, small-scale decentralised heat utilisation is highly feasible and much more energy efficient.

*Public acceptance:* Insulation standards in the Tochigi Prefecture are much lower than in other regions of Japan. Students from Utsunomiya University expressed their concern about the inefficient insulation standards of buildings, and at the same time the need to increase energy efficiency, supporting the idea of heat utilisation including solar heat use and geothermal heat pump solutions.

## Key Lessons Learned

*Communication and engagement across stakeholders and across time:* Involving citizens and having continuous dialogue with them is essential to understand their needs and concerns, but also for them to contribute with their ideas and solutions. As such, efforts to reach all parts of the population will lead to the best insights. This is crucial in the ageing context of Utsunomiya, where elderly people's voices must be heard and accounted for. Moreover, communication is core to assessing and facilitating public acceptance. When it comes to projects involving businesses, academia, etc, collaboration generates rich learnings and builds trust. This is especially true for initiatives involving several companies: there is much more to gain when working towards common goals together rather than in competition with each other. Developing trust is not an overnight process, change takes time, but a collaborative mindset is the only way forward in facing today's challenges.

*Combination of hard and soft measures:* A successful support system calls for behavioural measures that align with the right infrastructural network. In the case of Utsunomiya, it is not enough to encourage citizens to adopt more sustainable lifestyles. For their mindset and habits to change, the municipality must provide them with an adequate built environment. To that end, infrastructure must be designed by putting users' needs at the centre.

*Testing and failing approach:* A significant part of any successful measure is trial and error. Failure allows learning and improvement, it gives birth to novel perspectives and solutions. One fruitful way of approaching a project is to start small-scale with testbeds and pilot projects before scaling up. In most cities, certain areas or districts have certain characteristics that make them particularly suitable as test labs. These can be used to experiment with innovative solutions based on what residents need and want. With time, such areas tend to build up a reputation and start attracting more and more innovators. It is common for new ideas to be met with resistance from the public and businesses at first.

Small-scale initiatives represent great opportunities to build on negative perceptions and feedback. Overall, the key is to work on a management culture that fosters flexibility, adaptability and that embraces failure for its learning potential. Or, as heard during one interview, "Don't focus on failures, but on the knowledge gained!" (Chairman Testbed Gothenburg at Business Region Göteborg)

## Conclusion

Our project has confirmed that building a cleaner city comes with many challenges

and cannot be achieved overnight. Successful decarbonisation calls for a flexible mindset combined with a collaborative approach.

There are countless models around the world to learn from. We hope that the new perspectives we are offering Utsunomiya will inspire them just as much as they have inspired us!

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### List of people interviewed

Associate Professor, The International Institute for Industrial Environmental Economics, Lund University, 11 October 2022

Brunnhög Project Manager, City of Lund, 24 October 2022

Clusters & Innovation Director, Business Region Göteborg AB, 31 October 2022

Lecturer, The International Institute for Industrial Environmental Economics, Lund University, 11 October 2022

Mobility Management Coach, City of Lund, 28 October 2022

Postdoctoral Researcher of Chalmers University of Technology, 25 October 2022

Professor, The International Institute for Industrial Environmental Economics, Lund University, 20 October 2022

Researcher, The International Institute for Industrial Environmental Economics, Lund University & Investigator, City of Malmö, 12 October 2022

Senior Research Project Manager of Research Institute of Sweden, 27 October 2022

Sustainability Manager, Göteborg Energi, 28 October 2022

Sustainability Strategist, City of Malmö, 13 October 2022

Traffic Planner, City of Malmö, 24 October 2022





**Charging Forward - Electric  
Road System for the City of  
Perth, Scotland**



*Eva, Jakub, Markas and Leon during the final stakeholder workshop at Aviva's HQ, Perth*

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## The team

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**Leon Bartling** holds a B.Sc. in Management & Economics from Witten/Herdecke University. His experience includes a traineeship in sustainable finance, working as a customer advisor in a financial institution, and strategic sustainability consulting.

**Markas Ažuolas** holds a B.A. in Environmental Geography from the University of Manchester. His experience includes working as a mobility planning specialist at the government, with a focus on sustainability policy, urban experimentation, and social equity.

# Charging Forward – Electric Road System for the City of Perth, Scotland

Eva Andersson, Jakub Gamrot, Leon Bartling, Markas Azoulas

## Introduction

In 2019, the transport and mobility sector accounted for 30% of all greenhouse gas (GHG) emissions in Scotland, of which road transport accounted for 70% [1]. The Scottish Government has thus set ambitious climate targets to address this issue, aiming for net-zero emissions by 2045. Decarbonising the transport and mobility sector is a top priority. By 2030, policymakers are aiming for a 75% reduction in GHG emissions, 20% reduction in vehicle kilometres, and no new combustion vehicles [2]. The reductions in GHG emissions will also reduce air pollution, which in 2018 caused 1,700 premature deaths in Scotland [3].

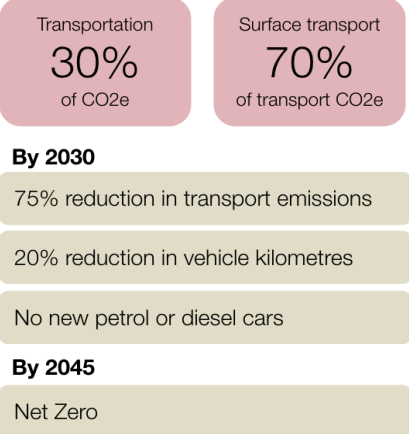


Figure 1: CO2 emissions and climate targets in Scotland

To achieve this, measures aimed at reduction in miles travelled, electrification of private vehicles, public transport, and last-mile delivery will be required.

Local governments will play a critical role in implementing solutions to reduce transport related GHG emissions. This report identifies the potential of an Electric Road System (ERS), an infrastructural solution that allows electric vehicles to charge while driving, for the local context of Perth.

## Project Description

### Context

The city of Perth has a population of 50 000 and is located in Scotland’s Tay River region. Surrounded by large cities such as Glasgow and Edinburgh, Perth sits at a major transportation node linking Scotland’s northern and southern parts (see Figure 2) [5]. The scale of transport-related GHG emissions in Scotland is particularly concerning in Perth, as they account for 52% of Perth's total GHG emissions [4].

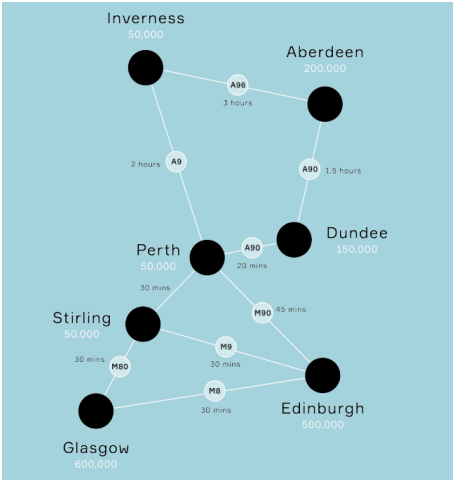


Figure 2: Perth's strategic location as a transportation node



The local Council of Perth and Kinross (PKC) has an ambitious climate strategy that links decarbonisation with sustainable growth, job creation, health and wellbeing and renewable energy generation. Perth West, a 240-hectare new residential and commercial urban development project in the western part of the city, is part of this climate and net-zero strategy that aims to integrate logistics, clean energy, transport, and housing in a comprehensive way [5].

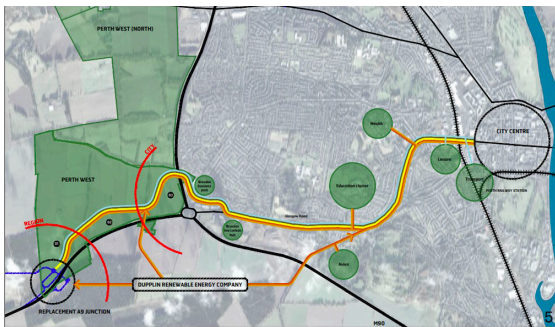


Figure 3: Perth Innovation Highway as part of the Perth West Development

The Perth Innovation Highway (see figure 3) is a key component of Perth West’s development. It is planned to become a 10 km long corridor integrating energy, mobility, and digital infrastructure, consisting of both digital and physical infrastructure. It will help Perth’s advancement of urban mobility solutions, including a creation of a possible mobility hub, a logistics centre for last-mile-delivery and improvements of public transport to and from the urban centre [5].

### *Task, Objectives & Scope*

The research project’s goal is to explore the potential of implementing an ERS as part of the broader mobility strategy for Perth, with a geographical focus on the proposed Perth Innovation Highway. The project focuses on mapping stakeholders’ current and future needs, opportunities, challenges, and identifying synergies associated with the

implementation of an ERS for road-based public transport and urban logistics. Gathering stakeholder perceptions will provide a basis for further decision-making on this topic and contribute to the exploration of potential infrastructure and governance models that offer scalable solutions for the decarbonisation of road-based public transport and urban logistics. The key questions answered in this project include:

1. What stakeholders' needs could be met through the implementation of a, road-based ERS?
2. What challenges and opportunities do key stakeholders foresee in implementing a road-based ERS?
3. What synergies can be derived from the collected stakeholder input?

### *The Clients*

For this project, the research team worked with several partners and clients. Our direct client was Ristol Consulting Ltd., an urban planning consulting business advising the PKC on the Perth West development. Next, there is the PKC’s Mobility Board, which is tasked with implementing programmes to support decarbonising Perth’s road-based public transportation and urban logistics. This final report will help these stakeholders in guiding the course of their future decision making. Finally, there's Elonroad AB, the company providing conductive ERS solutions. As the project builds upon Elonroad's ERS solution, the findings of this report will also contribute to further development and future-proofing of the solution.

### *Research Approach*

To untangle the complex stakeholder perception landscape for an ERS implementation in Perth, the research design followed five systematic steps (see Figure 5).





Figure 4: Derived stakeholders' perspectives from interviews & workshop and their categorisation into sub-system

Firstly, detailed background research was performed to obtain necessary insights on the local context of Perth. This was accompanied by research on technical, operational, and administrative characteristics of the ERS system and existing pilot applications. Our team had an on-site visit at Elonroad's site, to obtain a more holistic understanding of how the technology works in practice.

Secondly, 13 stakeholder consultations – in the form of semi-structured interviews – were conducted both online and on-site with professionals from different sectors, including local council representatives, urban planning specialists, logistics and freight companies, academics, investors, and public transport operators. The interviewed stakeholders were categorised into six sub-systems, depending on their expertise, as detailed in Figure 4. Thus, allowing to identify, needs, opportunities, challenges and synergies from urban development, user, research, investment, technological, and local retailer perspectives.

The inputs from the expert consultations were supplemented by informal interviews with small and medium-sized local retailers to identify the frequency of everyday

deliveries and challenges linked to the current logistics. This was particularly significant for determining the geographical areas and strategic transportation nodes where implementing an ERS system could make sense.

A stakeholder workshop was organised as a follow-up exercise with 11 relevant stakeholders to further discuss initially discovered opportunities and challenges and spotlight potential synergies between different sectors. During the workshop, the preliminary study results were presented, stakeholders identified challenges and opportunities of an ERS, and a backcasting exercise was initiated to recognise short and long-term synergies and partnerships required for an ERS pilot in Perth.

An inductive coding approach was utilised to analyse the data gathered during the interviews and workshop. The outputs were categorised into six main themes: urban planning, stakeholders, technology, energy, economics, and environment (see Figure 5).

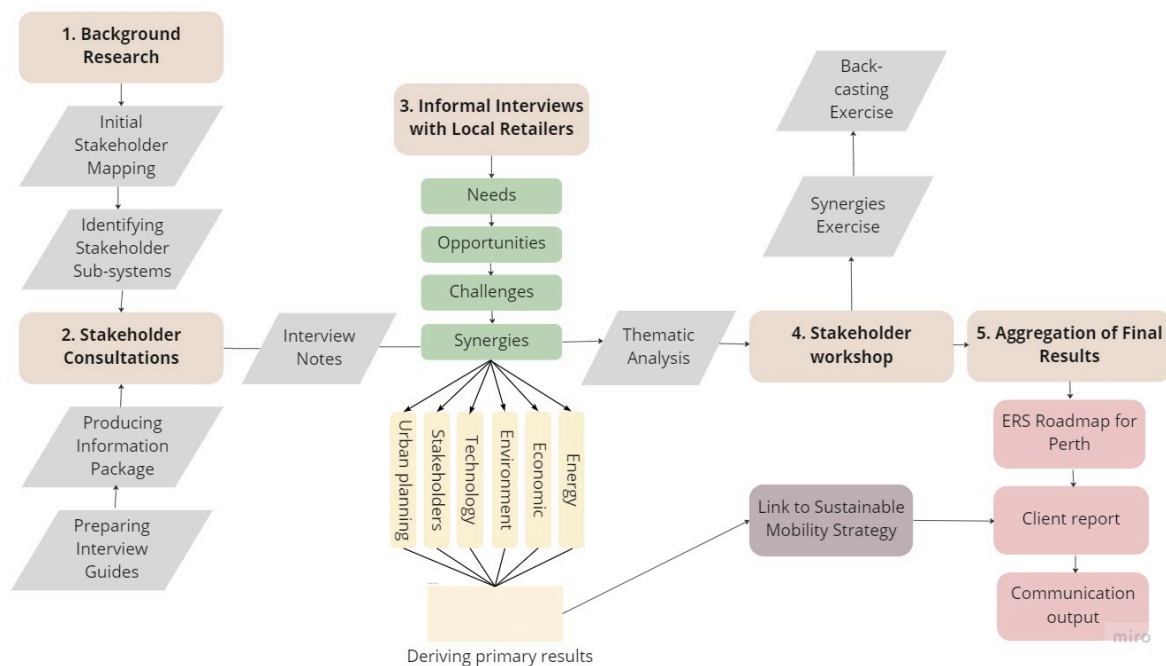


Figure 5: Methodological framework for data collection and analysis

## Electric Road Systems

### ERS Technology

An ERS allows electric vehicles to be charged while driving and serves as a collective term for a range of charging solutions, including inductive and conductive electricity transfer systems. Inductive ERS solutions (e.g., Electreon), provide wireless electricity transmission via magnetic coils embedded in the vehicle and the road. Conductive ERS solutions transmit electricity using, for example, an overhead line system (e.g., Siemens) or a road-based rail (e.g., Elonroad/Evivas). The energy is transferred to the vehicle via a physical conductor installed under or on top of the vehicle [6]. This research project focuses explicitly on a road-based conductive ERS due to its:

- a) higher energy efficiency
- b) ease of installation and ability to retrofit
- c) transferability of the already existing solution

### Elonroad – Conductive Charging

Elonroad AB is a mobility infrastructure startup based in Lund, Sweden, that designs and manufactures ERS solutions for on-road conductive charging of all types of electric vehicles (EVs). The charging system enables dynamic charging on-the-fly and stationary charging whenever the vehicle is parked, without any traditional cable-based charging infrastructure. When parking or driving over the rail, the pick-up slides along the rail, activates the charging segment installed every metre and the vehicle battery is charged with a high efficiency of 97% [7]. The Elonroad hardware consists of three components (see Figure 7):

- 1) **Conductive rail** either mounted on top of the asphalt (stationary) or immersed in the asphalt (dynamic)
- 2) **Pick-up device** that is mounted underneath the vehicle
- 3) **Power station** next to the road stretch



Figure 6: Key benefits of Elonroad's solution

Both the pick-up and the rail can be retrofitted for all electric vehicles (private EVs, electric buses, trucks, vans, etc.) and asphalted roads. The rail actively transmits electricity only when covered by the vehicle, thus making it safe in urban environments. Elonroad's hardware is supported by software enabling real-time data transmission and smart billing opportunities. It informs the central system and the customer about road conditions, safety, and state of charge (SoC). The software solution also enables load balancing, meaning that it can prioritise vehicles with the lowest SoC and balance grid peaks. The main benefits of the Elonroad solution are presented in Figure 6.

### Stakeholder Mapping

Introducing an ERS in Perth would involve many relevant stakeholders which need to be considered and addressed accordingly. A stakeholder mapping exercise has been performed to pinpoint the most influential actors, their interrelations, and synergies (see Figure 8). PKC is a central stakeholder as it is responsible for any pertinent changes in terms of legislation, land use and overall logistical planning at a city-scale to support new infrastructural developments.

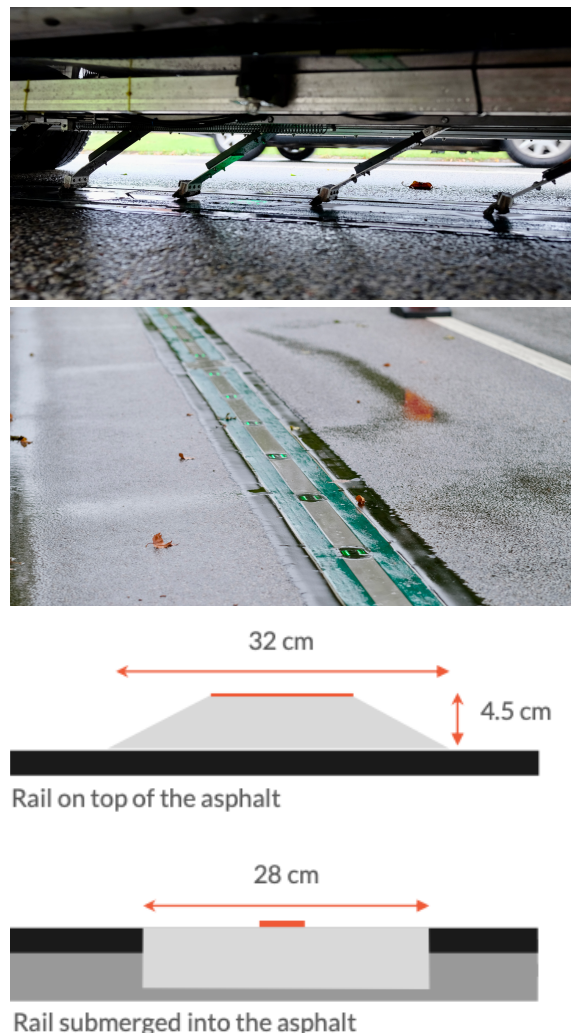


Figure 7: Conductive pick-up under the vehicle and the implementation of the rail

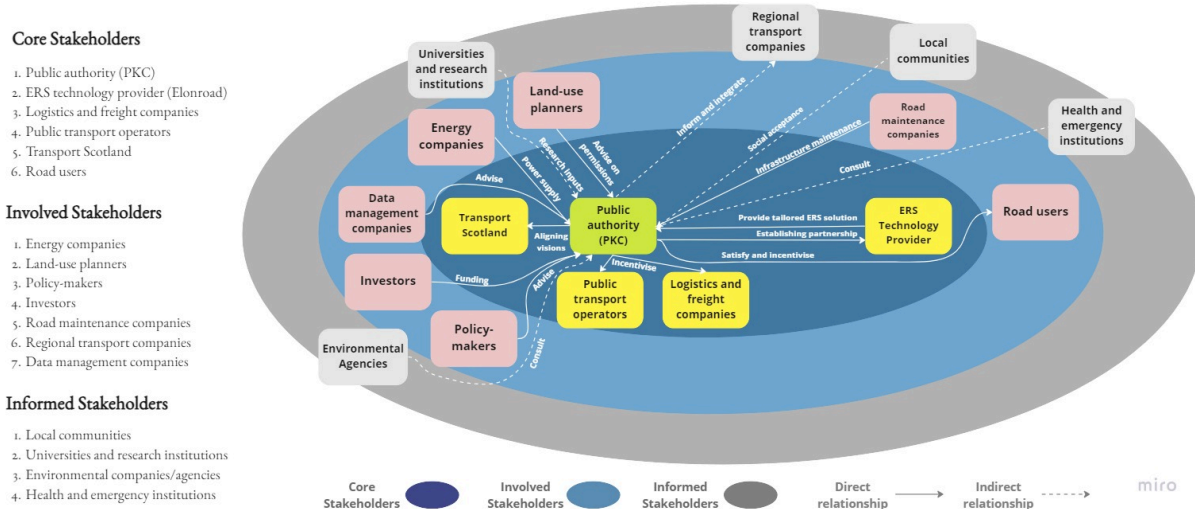


Figure 8: Stakeholder mapping for ERS implementation in Perth

The PKC would also be a fundamental actor in facilitating public-private partnerships and establishing primary operational and administrative capacities. It would be pertinent for the PKC in keeping a close collaboration with the ERS solution providers to assure that the system's hardware and software could be adapted to Perth's context appropriately. Simultaneously, there are clear collaborative opportunities with public transport operators and logistics and freight companies (e.g., Royal Mail, DPD) as they have been identified as main potential users of the system. Other significant stakeholders whose involvement is of high interest are local energy and data companies, primary health and emergency services, road maintenance companies, regional transportation companies, local investors, and Transport Scotland whose inputs would be imperative for technical implementation, funding, and strategic planning of ERS solutions in Perth.

Less directly involved, yet important, stakeholders are universities and other research institutions, environmental agencies and

the local community which holds less direct influence and interest in driving changes yet should be appropriately informed and consulted when introducing ERS-based solutions. Research institutions would potentially play a significant role in bridging knowledge gaps, while communication with local and regional environmental agencies would prevent potential adverse environmental side effects and trade-offs when implementing.

## Findings

This section compiles the main takeaways from the stakeholder interviews and the workshop and considers if an ERS would be a viable option to support decarbonisation of Perth's public transportation and urban logistics. The first part, "General Application," presents overall stakeholder perceptions based on six thematic areas (see Figure 10). In the next step, three ERS use cases were developed to demonstrate how an ERS could be used in Perth and provide a preliminary assessment of its suitability.



## *General Application*

In many ways, an ERS makes sense in Perth. From an environmental perspective, there are ambitious national and local climate targets that mandate decarbonisation of transport. An ERS could help accelerate this transition, spur electrification of road-based public transport and urban logistics and improve local air quality.

Furthermore, many stakeholders emphasise that electrification of transport is an important step towards reaching net-zero targets. However, in this pursuit of electrification, energy grid capacity constraints are a considerable concern. Nevertheless, the technology provided by Elonroad showcases opportunities, despite an overarching need for increased renewable energy and grid resilience. With smart load balancing technology, the ERS can provide optimal charging for users based on the battery state. Fundamentally, however, load balancing can help alleviate a highly pressured energy system by balancing energy use during peak hours. This makes the ERS an interesting option among electrification solutions, and stakeholders have probed the question if an ERS even could improve grid resilience and facilitate transitions to local peer-to-peer microgrids due to its smart data software. While an ERS alone will not be the solution to future energy grid stability, it may play a valuable part in a future intelligent energy system.

From an economic perspective, there appears to exist a promising investment landscape for sustainable ventures, with strong public commitment for investments in infrastructure projects that decarbonise mobility. However, the public sector needs help to scale up. While it can initiate and finance a pilot, at some point the private sector will

need to take responsibility for scaling up. Many interviews therefore highlighted the role of collaboration among stakeholders and the opportunities for public-private partnerships. An overarching concern in all dialogues, however, is how to make an ERS cost-effective, and a clear business case must exist for an ERS to be an attractive solution for users, or an attractive investment.

If adopted, many stakeholders highlighted how an ERS could be beneficial to the region in terms of branding the city as sustainable, attracting skilled workers, and even developing a new local industry – especially if manufacturing of the ERS took place in the area. The ERS also appears to integrate effectively with existing urban planning strategies for Perth.

Local council members imagined an ERS as complementary to current transportation strategies and pointed out how the solution would be compatible with measures to promote active modes of transportation and shifts towards public transportation. A relevant concern, however, is if an ERS may incentivise continued private car use and conflict with vehicle mileage reduction targets. This emphasises the need to consider precisely in which use cases the technology makes sense – and in which cases it does not. These scenarios will be explored in the following section.



*Figure 9: Dynamic ERS in urban environment*

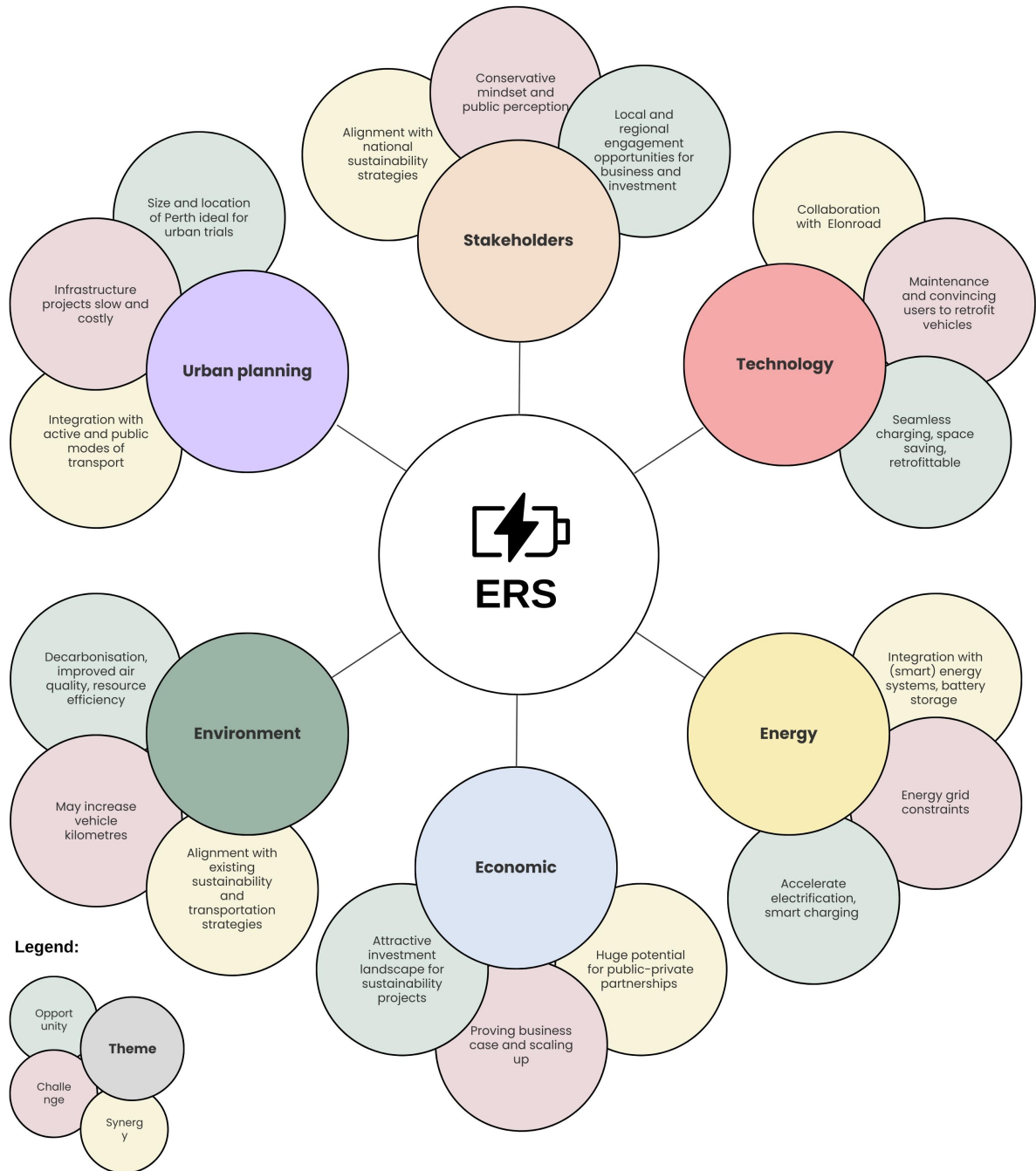


Figure 10: Stakeholders' perception on ERS implementation in Perth

### Use Case 1: Stationary charging for public transportation

Public transportation has been identified as one key ERS use case. Stagecoach, the local bus company, has already committed to electrification targets, and effective charging infrastructure is a key condition for success. The stationary chargers can be used in bus depots for charging overnight, which would save time, space, and increase convenience. If stationary chargers are added to strategic bus stops as well, this enables extended range, and in turn, battery sizes can be reduced. The fixed schedules of public transport arguably facilitate successful implementation of an ERS as routes are predictable.

One exciting prospect mentioned in an interview was that a bus company could use the smart load balancing software to act as a battery storage system, which could be used to balance energy peaks in the grid. If the energy stored in the bus's battery could be fed back into the grid via the ERS, an ERS could potentially become a revenue stream, and turn the ERS into a source of revenue.

It could be worthwhile to further explore to further explore these ERS-based vehicle-to-grid opportunities. Overall, Elonroad's solution offers a cost-competitive alternative to conventional charging infrastructure. At a minimum, opportunities are tied to convenience and saving time and space. In the long-term, it is possible that the ERS can offer greater solutions as smart technology integrates energy and mobility solutions. When exploring application of the ERS for public transport, there are no obvious challenges tied directly to the ERS technology itself, but rather to the greater electrification journey.



Figure 11: Stagecoach bus depot in Perth

### Use Case 1: Saving time and space

Theme	Needs	Opportunities	Challenges
<i>Energy</i>	<ul style="list-style-type: none"> <li>Develop charging infrastructure in the city</li> <li>Battery longevity + optimal level of charge</li> <li>Minimise charging time</li> </ul>	<ul style="list-style-type: none"> <li>Saves space at depots</li> <li>Saves charging time</li> <li>Optimise bus and battery sizes</li> <li>Integration with smart energy grid</li> <li>New revenue streams (battery stacks, EV to grid)</li> </ul>	<ul style="list-style-type: none"> <li>Price of energy</li> <li>Energy grid constraints</li> </ul>
<i>Economics</i>	<ul style="list-style-type: none"> <li>Charging solution that simplifies operational practices</li> <li>Cost-efficient decarbonisation strategy</li> </ul>	<ul style="list-style-type: none"> <li>PPPs between bus operator, public sector, energy provider</li> <li>Potential cost reduction as compared to alternative systems</li> </ul>	<ul style="list-style-type: none"> <li>Cost of zero-emission vehicles</li> <li>Limited funding for public transportation</li> </ul>
<i>Urban planning</i>	<ul style="list-style-type: none"> <li>Develop sustainable mobility options</li> <li>Mode-switching</li> <li>Access to mobility in the city centre (especially if pedestrianised)</li> </ul>	<ul style="list-style-type: none"> <li>Complement pedestrianisation</li> <li>Predictable time schedules facilitate feasible implementation</li> <li>Space saving in urban setting</li> </ul>	<ul style="list-style-type: none"> <li>Large rural population that may be unwilling to shift to public transportation</li> </ul>
<i>Technology</i>	<ul style="list-style-type: none"> <li>Save space in bus depots</li> </ul>	<ul style="list-style-type: none"> <li>Bus manufacturer located in Scotland (possible local collaboration)</li> <li>Easy to retrofit</li> </ul>	<ul style="list-style-type: none"> <li>Operators need to understand retrofitting is easy and safe</li> </ul>

### Use Case 2: Stationary charging for urban logistics

An ERS can be utilised for decarbonising urban logistics and last-mile-deliveries. Replacing short freight transports to city centres with electrified solutions would reduce GHG emissions and local air pollution and align with greater strategies for reducing traffic in urban settings.

The use case for applying an ERS to an urban logistics system consists of having stationary charging points at strategic locations for (un)loading – where a vehicle would be standing still regardless. This would enable extended range, and in turn, battery sizes could be reduced. The logistics sector is decarbonising, and while many are looking towards electrification as an alternative. Standardisation is, however, key for determining future pathways. The primary driver for getting users on board is demonstrating a low cost per tonne kilometre, as most customers are reluctant to pay additional costs.

Here, the prospect of reducing battery sizes is the most interesting advantage as it enables greater cargo loads and reduces the financial burden of large, heavy batteries. While utilising an ERS for truck freight could decarbonise road transport’s heaviest emitters, it is crucial to consider which transportation distances would be possible under different levels of implementation. From a technological point of view, applying an ERS purely for last mile deliveries, however, constitutes a convincing case. The challenge would largely lie in abilities to consolidate urban deliveries and predicting freight movements, and it would be key to have urban logistic companies on board as first movers during trials.



Figure 12: Stationary charging while (un)loading at a warehouse

### Use Case 2: Greener, smarter, faster

Theme	Needs	Opportunities	Challenges
Energy	<ul style="list-style-type: none"> <li>Sufficient charging infrastructure</li> <li>Sufficient energy grid capacity</li> </ul>	<ul style="list-style-type: none"> <li>Smaller batteries enable more cargo</li> <li>Supports existing strategies for fleet electrification</li> </ul>	<ul style="list-style-type: none"> <li>Price of energy</li> <li>Energy grid constraints</li> </ul>
Economics	<ul style="list-style-type: none"> <li>Competitive price per tonne kilometre</li> <li>Cost-efficient decarbonisation strategy</li> </ul>	<ul style="list-style-type: none"> <li>Cheaper compared to hydrogen</li> <li>Can be installed immediately</li> <li>Monetary benefits of smaller batteries enabling more cargo</li> </ul>	<ul style="list-style-type: none"> <li>Cost structure and billing model</li> <li>Customers reluctant to pay extra cost</li> </ul>
Urban planning	<ul style="list-style-type: none"> <li>Reduce vehicular traffic</li> <li>Create low emission zone in the urban core</li> </ul>	<ul style="list-style-type: none"> <li>Physical limitations of conventional charging poles</li> <li>Pedestrianised city centre very likely in the future</li> <li>Mobility hub at the edge of the city</li> <li>Replace short freight movements by alternative modes</li> <li>Integration with rail and river</li> </ul>	<ul style="list-style-type: none"> <li>Gap in knowledge of freight movements</li> <li>Fragmented logistics sector</li> </ul>
Technology	<ul style="list-style-type: none"> <li>Electrification as a lever to reach net-zero</li> <li>Standardisation</li> <li>Convenient charging infrastructure</li> </ul>	<ul style="list-style-type: none"> <li>Fossil fuels trucks to be phased out</li> <li>Transportation sector largest emitter of CO<sub>2</sub></li> </ul>	<ul style="list-style-type: none"> <li>Supplier engagement</li> <li>Accounting for flexibility of mobility sector</li> <li>Many different actors delivering goods</li> </ul>



### *Use Case 3: Dynamic charging on public roads*

For a dynamic ERS, the charging infrastructure would be integrated into a public road allowing it to be used by anyone who has retrofitted a vehicle with a pick-up. Notably, the road would have to be long enough for a vehicle to reach a sufficient charge when using the system. For this scenario, the primary users are imagined within urban logistics and public transport. The proposal, as such, would be to integrate dynamic charging on critical road stretches highly trafficked by public transport and delivery vehicles. From a technological perspective, a dynamic ERS offers the greatest potential in terms of reducing range anxiety and accelerating the expansion of charging infrastructure.

When speaking with stakeholders, two main roads were suggested: Glasgow Road and Dunkeld Road. Glasgow Road would act as the connector to Perth West and could integrate well with the planned development of the Perth Innovation Highway. Dunkeld Road, which is currently undergoing a retrofit,

also demonstrates how Elonroad’s solution does not require a full reconstruction of a road, but can be retrofitted to any existing, asphalted street. One of the biggest questions, when implementing a dynamic ERS is if there is sufficient grid capacity to support the system. It is therefore fundamental to combine the development of an ERS with parallel investments in renewable energy infrastructure.

An important question that was raised circled around responsibilities for maintenance of the road. In terms of ownership, a council member queried if an ERS in fact could enable opportunities to generate revenues off a road – a utility which typically only has costs, and if so, who would be able to participate in such a cost structure.

While the idea, in theory, aligns well with electrification strategies, it remains to be seen how it would be used in practice and scaled up. The main challenges as such might therefore involve ensuring users adopt the system, as well as navigating standardisation and technological advancement.

### *Use Case 3: Innovation, Integration, Inspiration*

<b>Theme</b>	<b>Needs</b>	<b>Opportunities</b>	<b>Challenges</b>
<i>Energy</i>	<ul style="list-style-type: none"> <li>• Integration with energy network</li> <li>• Development of substations</li> </ul>	<ul style="list-style-type: none"> <li>• PKC developing EV charging strategy - possible integration</li> </ul>	<ul style="list-style-type: none"> <li>• Energy grid constraints</li> <li>• Transmission capacity</li> </ul>
<i>Economics</i>	<ul style="list-style-type: none"> <li>• Cost-efficient decarbonisation strategy</li> </ul>	<ul style="list-style-type: none"> <li>• PPPs</li> <li>• Access to funding</li> </ul>	<ul style="list-style-type: none"> <li>• Billing and payment model</li> <li>• Scaling up</li> <li>• Maintenance model</li> </ul>
<i>Urban planning</i>	<ul style="list-style-type: none"> <li>• Long enough stretch of ERS enabled road</li> <li>• Avoid disruptions during installation</li> <li>• Integrate Perth West with existing built space</li> </ul>	<ul style="list-style-type: none"> <li>• Retrofit Glasgow Road leading into the city</li> <li>• Dunkeld Road as primary corridor</li> <li>• Relatively easy to install</li> <li>• Synergy with other systems (i.e. energy)</li> </ul>	<ul style="list-style-type: none"> <li>• Standardisation</li> <li>• Legislative and regulatory matters</li> <li>• Integration with rural hinterland</li> </ul>
<i>Technology</i>	<ul style="list-style-type: none"> <li>• Charging infrastructure compatible with all vehicles and paved roads</li> </ul>	<ul style="list-style-type: none"> <li>• Traffic data extraction</li> </ul>	<ul style="list-style-type: none"> <li>• Operators need to understand retrofitting is easy and safe</li> </ul>

## Findings

In order to successfully implement and deploy an ERS in Perth, we recommend considering these key messages.

### **The City of Perth is well suited to spearhead an urban ERS trial**

Perth benefits from an enabling environment for urban experimentation due to its size, and its central position in the heart of Scotland. Key stakeholders and local actors are enthusiastic about the city's development and are ambitious about positioning Perth as a sustainable innovation hub in Scotland. As a first-mover, Perth could utilise the funding opportunities which exist for sustainability and infrastructure projects that support the regional and national climate and electrification targets and strategies.

### **Collaborative action is needed to move together**

Energy, transportation, urban planning, residents, research, and public bodies must all be involved to maximise the potential of an ERS in Perth. The technology can support inclusive and sustainable development if implemented correctly. For this, meaningful dialogue, involvement, and collaboration with residents and potential users is an important precondition. Additionally, actors within the energy sector play a critical role as the development of an ERS needs to happen hand in hand with the expansion of renewable power and bolstering of the energy network.

### **To succeed, a technology demonstrator is needed**

Soft-launching on a limited scale is the best course of action as it creates visibility and generates the data needed to build the

project case further, without the need for excessive bureaucracy or prohibitively large investments. Collaborating with the Swedish Transportation Agency and its partners who have been trialling the EVolution Road ERS in Lund, Sweden, on sharing know-how and facilitating knowledge transfer, constitutes an exciting opportunity to fast-track the project in Perth.

### **To scale up, a business case must be built**

A clear business case must exist for an ERS to be an attractive solution for users and to attract long-term investment. Provided that an innovative operational model is developed, an ERS could unlock a range of substantial benefits for the city in terms of accelerating electrification, improving air quality, developing a new local industry, branding and reputation, to mention a few.

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## **Battery-Storage-as-a-Service: Exploring Opportunities with Volvo Energy**



*Gunjan, Luca and Inès*

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## The Team

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# Battery-Storage-as-a Service:

## Exploring Opportunities with Volvo Energy

### Introduction

In the face of climate change, a reduction in greenhouse gas emissions from all industries is paramount. Taking part in these global efforts, the Volvo Group (hereafter Volvo AB) has committed to a sustainability strategy centred around offering solely fossil-free products from 2040 onwards. As an international manufacturer of trucks, construction equipment, buses, and marine power systems, this effectively will result in an electrification of the majority of the company's fleet. Volvo Energy, Volvo AB's most recent business area, has been tasked with supporting this electrification journey.

This has an important consequence: as Volvo AB's fleet goes electric, an increasingly large amount of used electric batteries

– batteries no longer fit for usage in electric vehicles – will inevitably be produced. This poses a strong problem of *uncaptured residual value*, in economic as well as in resource extraction terms. Indeed, it is estimated that once a battery is no longer fit to run an electric motor, around 80% of its usable capacity remains. A question at the top of Volvo Energy's agenda is thus addressing these used batteries in an optimal way.

One proposed solution to harness this potential is through a *second-life opportunity*, by combining several used batteries together to create a stationary super battery, a *Battery Electric Storage System (BESS)*. This would stand as an alternative to directly recycling used batteries for materials.



Figure 1: An example of a BESS

In practical terms, Volvo Energy is exploring a solution that would offer BESSs with a capacity ranging from 200 to 2000 kWh. This would represent a *fundamentally new type of business activity for Volvo AB*, who is currently not operating in the BESS space. An additional characteristic of a future Volvo AB BESS offering currently under consideration is the so-called “*Battery-Storage-as-a-Service*” (*BaaS*), where a BESS would be sold as a service and not as a product. This means that, as end-users purchase Volvo AB’s BaaS services, the company would retain the ownership of the equipment during its operational and end-of-life phases, also providing maintenance and upkeep. This would allow for battery performance optimisation and sound end-of-life management, as well as addressing the expected high upfront cost which could put off prospective end-users.

## The project

Given the novel market area that a BaaS offering represents for Volvo AB, it is currently a priority for Volvo Energy to bridge its knowledge gap in the space. Specifically, a better understanding of BESS market conditions, potential end-users, as well as the actors and processes within the electricity grid that are essential to a successful BESS offering is paramount.

Our team was thus tasked with the following as our four-week research project.

*Objective:* To support Volvo Energy in building market intelligence in the BESS space, focusing on potential end-users, their needs, and perceptions, as well as other important actors and processes of the electricity grid. End-users’ perceptions are further subdivided in three categories: perceptions towards Volvo AB as a provider, towards a BaaS offering, and towards second-life batteries.

*Scope:* Behind-the-meter applications (storage systems installed at the end-user’s location) for Commercial and Industrial end-users in Sweden. This excluded all household applications (considered too small for the offered capacity), all utilities and power generation applications (considered too large), as well as Volvo AB’s existing customer base.

## Methods

This project applied desktop research and experts and practitioners’ interviews (both on-line and in-person) through a *5-step process*.

*Step 1- Knowledge Building.* Our first focus was to build foundational knowledge in the BESS space given its markedly technical nature. A review of academic literature, company websites as well as corporate reports was undertaken, providing us with a theoretical background as well as ‘real-life’ BESS use-cases for reference.

Following this, we identified industrial and commercial actors’ groups that may particularly benefit from BESS use. Logically, such actors tend to have high electricity peaks in their power usage, and/or use infrastructure which cannot afford to experience power shortages (“critical infrastructure”).

Based on these characteristics, “good BESS candidates” include: dairy farms, bakeries, sawmills, paper and pulp producers, metal manufacturers, car dealerships, property groups, logistic centres, ports, data centres, telecom systems, large hotels, hospitals, universities and educational sites, as well as municipalities. To note, this is not to be understood as a complete and final list of all sectors in which BESS applications are possible.

*Step 2- Stakeholder Mapping.* Using knowledge of the BESS space facilitated a mapping of the Swedish electricity value chain in the context of BESS applications to determine its key actors. A visual representation is provided in Figure 1, and a more extensive explanation of these actors is provided in the Results section.

*Step 3 – Outreach.* This phase involved attempts to make contact with companies that were part of either our end-users list or that had other key actors in the Swedish electricity grid, in order to conduct interviews. Reflecting a lack of an existing network in the space (for both Volvo AB and the IIIIEE), a ‘mass outreach’ approach was used and a total of 92 leads were contacted.

*Step 4 – Interviews.* A total of 16 structured interviews (in–person and on–line) were secured. Tailored interview guides were

created for each interviewee category, and all interviews were recorded with the participants’ consent. A list of interviewees is provided in the annex.

*Step 5 – Content compilation and analysis.* In order to find common patterns and narratives, the content of these interviews was then analysed using qualitative data coding. Our results, presented in the next section, are divided into two sections. Firstly, our findings regarding end-user profiles and needs, and perceptions of BESS offerings. Secondly, our findings related to operational aspects and actors that are key to the BESS space.

## The electricity value chain with BESS applications

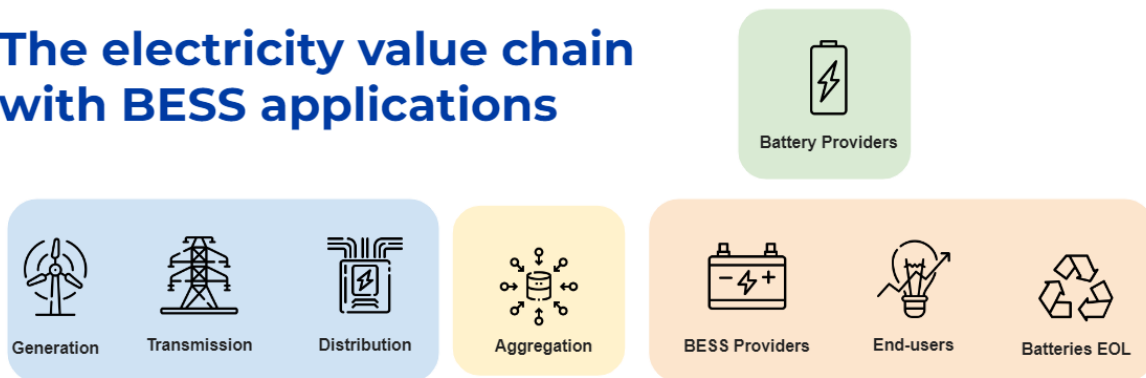


Figure 2: The electricity value chain within the context of BESS applications

## Findings: End-User Profiles, Needs and Perceptions

### *BESS end-uses*

Two key motivations were identified for end-users to engage with BESSs: economic considerations and resiliency considerations. These are seen as part of a so-called *Value Continuum*, where the two considerations are not mutually exclusive, but one of them typically dominates over the other.

No application related to these considerations was found to be more important than the others, except for off-grid applications which were mentioned less frequently by our interviewees. These findings are summarised in Figure 2.

Under *economic considerations* are applications related, firstly, to revenue generation. This refers to the practices of frequency regulation – selling electricity back to the grid to ensure its stability; and of

energy arbitrage – purchasing electricity when prices are low and selling it back to the grid when they are high. Secondly, applications related to cost-cutting measures also exist. This is related to power quality needs, where a BESS is used as an alternative to upgrading a grid connection to increase power quality. In addition, peak shaving (reducing power consumption for a short time to avoid a spike) and load shifting (shifting electricity production spikes to a later time when prices or demand are lower) are two other key applications.

Under *resiliency considerations* came, firstly, energy self-sufficiency motivations. Secondly, applications related to critical infrastructure (infrastructure which cannot afford to experience power shortages); and thirdly, off-grid applications, which appeared less often than others in our research.

On-site renewable energy production, such as solar panels, can be understood as either an economic consideration by selling surplus electricity back to the grid, or a resiliency consideration by reinforcing energy sufficiency.

Drawing on our Value Continuum, we identified interviewed end-users in the logistics, mining, sawmilling and dairy farming sectors to be more driven by economic considerations. Actors in the port and hoteling sectors, as well as municipalities, tended to attach more weight to resiliency.

These two considerations, we observed, led to different expectations for what was valued in a BESS provider. End-users on the economic end of the spectrum tended to particularly value providers with high technical expertise, which helped them optimise the economic returns their BESS applications provided. On the other end, end-users on the resiliency end of spectrum prioritised providers with a strong brand, given their need for trust and security.

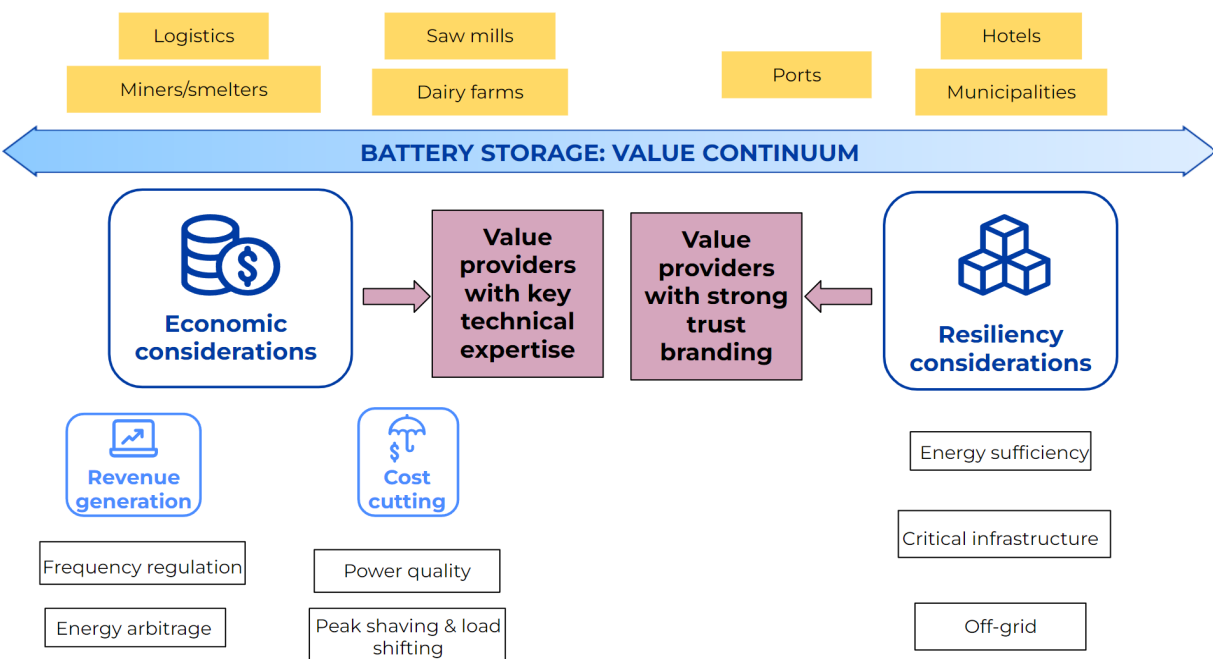


Figure 3: The battery storage value continuum



### *Perceptions of Volvo AB as a provider*

A general view that emerged in interviews was Volvo's strong brand and reputation. Overarchingly, interviewees perceived Volvo as a trustworthy and reliable actor.

The company was viewed as a potential BESS provider portraying continuity, given its track record in other industries- as opposed to potential new market players starting from scratch, that may not remain in the market altogether for a long time.

However, certain interview partners did voice concerns related to the lack of experience Volvo has in this specific market. In particular, grid actors noted that risk-averse BESS project investors may hesitate to trust new market entrants with no performance history.

### *Perceptions of BaaS*

With regards to an 'as-a-service' offering as opposed to a traditional product offering, we found *that combining a customised service with a standardised product* was expected from many interviewees. Informants especially highlighted the importance of standardised BESS modules that could easily be replaced in case of failure or malfunction, alongside performance guarantees that guaranteed reliability.

Furthermore, an individualised service offer seemed important due not only to the different end-user motivations to engage with BESS, but also due to different infrastructural conditions. Variations in grid connection, consumption patterns, and on-site connections lead to unique installation processes and require individualised feasibility analyses. Additionally, preferences regarding payment contract structures for a BaaS varied from end-user to end-user, based on availability of funds and attitudes

towards operational costs, suggesting the need for customised pricing.

That being said, it was observed throughout our interviews that many end-users were not completely familiar with the full range of possible BESS applications, especially related to revenue generation.

Similarly, we noted an overall lack of awareness related to some of the key theoretical benefits of an as-a-service model, such as the reduced financial risk for the end-user or the increased flexibility. We concluded that there is, in this regard, a *strong need for customer education* in the BaaS space.

Three other crucial characteristics of a BaaS offering were highlighted by end-users. Firstly, the *need for an end-to-end solution*, with logistical and IT challenges of a BESS installation and operation expected to be handled by the BaaS provider. Respondents expected no further commitments on their parts with third-party providers, instead wanting a 'packaged' solution from BaaS providers. Sharing extensive information with a BaaS provider on electricity contract structures and infrastructure set-ups did not appear to be a big issue for most respondents, as had been initially feared by Volvo Energy. This is favourable to a well-executed end-to-end solution, as an in-depth understanding of an end-user's structural conditions is required to provide strong and customised BaaS services.

Secondly, the importance of *favourable pricing* was noted by respondents, most of which explained that a prior economic feasibility assessment would be conducted by them before purchasing a BaaS offer. Providing prospective end-users with payback period and/or revenue stream projects may therefore be a crucial tool in entering the BaaS market as a provider.

Thirdly, many interviewees emphasised the importance of *strong customer service*- in particular in the form of timely and quality support during the BESS use-phase. Fears of not being prioritised by a large company such as Volvo were raised by some of our smaller end-users. Here, we saw capacity-building and further digitalisation of services as a strong way for Volvo to build its brand as a trusted, reliable BaaS provider.

### *Perceptions of second-life batteries*

Using second-life batteries as part of a BaaS application, as opposed to first-life batteries, elicited concerns from some potential end-users. The first concern related to the batteries' *performance*. End-users were sceptical that a battery used in a moving application such as an electric motor (leading to faster deterioration and many charging cycles) would be able to deliver the same performance as a first-life battery. Likewise, many potential end-users were not convinced that a battery provider could confidently guarantee the duration of a second-life battery's maximum performance phase. As such, providing credible performance guarantees and warranties seemed to be a critical consideration that second-life BESS or BaaS market entrants should keep in mind.

The second concern regards *spatial concerns*, where some end-users were reticent to use their valuable space on a battery with around 80% of usable capacity left. This was particularly key for our inner-city respondents.

Lastly, some end-users feared a *higher prices* for second-life batteries than for first-life ones, notably related to maintenance costs.

Interestingly, the *sustainability* advantage of second-life batteries over first-life ones was left unacknowledged by virtually all

interviewees. The fact that second-life batteries aid slowing resource extraction loops was mitigated by most respondents' perceptions of electric batteries as unsustainable given the conditions related to the mining of metals such as lithium ion. Instead, it is interpreted that sustainability considerations only played an indirect role. Interviewees described BESSs as an important support in the electrification of different sectors – which was universally perceived as sustainable – which by extension made battery technology sustainable.

Again, there seems to be *a strong need for customer education in the second-life battery space* to bring awareness to the potential sustainability advantages of these solutions. A summary of findings related to end-users' profiles, needs and perceptions can be found in the table on page 8.

## **Findings: Operational Aspects and Market Conditions**

### *Key Actors to Consider*

Evidence gathered in this project indicated that the following actors are crucial to consider, either as partners or as competitors, when entering the BaaS market.

#### *Transmission and Distribution Actors: Transmission System Operator (TSO)*

The Swedish national grid is managed by the public enterprise and authority Svenska Kraftnät (SvK), who has the overall responsibility for the grid's balance between production and consumption. SvK thus provides approval for participation in the frequency regulation market. This is done through prequalification tests that are used to ensure that the BESS can respond to frequency signal within a predefined time and that it can provide the requested active power for the duration of time needed.

BESS uses and values	Key motivations	Economic considerations (revenue generation, cost saving)
		Resiliency considerations (Energy resilience, crit. infrastructure, off-grid)
	Non-determining	Sustainability concerns
Volvo AB perceptions	General	Positive reputation, reliability, stability
	As a BESS provider	New offers are positive. Missing experience is seen as a concern
Perceptions of 'as-a-Service'	Key learnings from other aaS offers	Importance of standardised product, customized offers
	End-user criteria	End-to-end solutions, Service availability, Pricing
	Challenges	End-users' lack of knowledge on economic applications of BESS
Perceptions of second-life batteries	Concerns	Performance, Warranty, Inefficient usage of space, Increased prices
	Challenges	Lack of consideration of the main benefit: sustainability
	Key factors	Performance guarantee, Price

Figure 4: Summary of findings related to end-users' profiles, needs and perceptions

As such, a strong partnership with SvK is fundamental to any BESS/BaaS market entrant.

#### *Transmission and Distribution Actors: Distribution System Operators (DSOs)*

DSOs, or regional grid operators, are responsible for approving a battery's installation. When an end-user wants to connect a battery storage system to the grid, a pre-registration must be sent to the DSO, which performs calculations to assess impacts on the grid and provide approval.

A significant finding with DSOs was their relationship to BESS offerings. According to the Swedish electricity legislation, grid owners are not allowed to produce or trade electricity. Conclusively, DSOs are permitted to own their stored electricity solely for emergencies, and not for commercial purposes. It was observed that the three main companies operating the regional grid in Sweden, Vattenfall Eldistribution, Ellevio and E.ON Elnät Sverige, have established sister companies that can commercially operate energy storage systems (but do not manufacture batteries themselves).

These are Vattenfall Network Solutions, Ellevio Energy Solutions, and E. ON Energy.

As such, DSOs are not only a necessary partner for any BaaS market entrant, given the approval processes outlined above. They are also potential competitors to BESS and BaaS providers through their sister companies.

In addition, DSO subsidiaries may possess two crucial market advantages in comparison to other BESS/BaaS providers. Firstly, for end-users who also happen to be customers to the DSO's grid utility service - access to electricity consumption data and structural conditions is already established. Secondly, a "bundled offer" may then take place in providing end-users not only with grid coverage, but also with energy storage, as well as other services such as charging solutions.

Evidently, DSOs' role in the BESS/BaaS space can be both seen as a threat and as an opportunity, in particular in the form of partnerships.

#### *Aggregators*

Aggregators, which act as a middleman between end-users and DSOs/TSOs, contribute to the grid's balance by pooling electricity supply and demand and selling it to energy markets. These actors have developed algorithms for energy management systems (EMS) that communicate with all affected equipment in a BESS installation to optimise operations such as peak-shaving or frequency regulation. While adapting to market changes and maintaining a leading edge.

It has also been observed that BESS solution providers may also have an internal aggregator, instead of collaborating with an external party. This occurred in a use-case between a mining company (the end-user),

and two regional DSOs. Whether internal or external, aggregators were identified as an important actor for BESS/BaaS market entrants to consider for partnerships.

#### *Market opportunities*

When viewed as a whole, input from informants is interpreted to show an increased need for BESSs in the future Swedish electricity space, pointing to *strong market appetite*. This goes hand-in hand with observed *current favourable conditions* for the development of BESS/BaaS solutions, in particular the latest introduction by SvK in January 2022 of frequency containment reserve FCR-D+ to stabilise electricity frequency. In addition to this, it was observed that funding for BESS and BaaS solutions is presently available from different sources, including the Swedish Energy Agency, the Swedish Environmental Agency, and European Union projects.

Lastly, we concluded that existing Swedish use-cases have shown a *strong business case* for BESS/BaaS applications by proving the profitability of such projects with better-than-expected Return on Investment and payback periods. This was also observed for use-cases where on-site renewable energy generation was not possible.

#### *Challenges*

Despite the promising conditions mentioned above, three current market challenges were also observed. Firstly, one of the applications currently leading to BESSs' profitability is frequency regulation. That being said, multiple respondents pointed to the possibility of the frequency regulation market becoming saturated within the next five to ten years, leading to *uncertainty as to future market appetite* and the potential need for new revenue sources.

Secondly, *other ongoing market conditions may not be guaranteed* for different



BESS/BaaS projects. To illustrate, some existing use-cases that the team looked at were situated in the southern part of Sweden (where electricity prices are higher), which contributed to higher revenue and thus greater profitability. Additionally, some respondents pointed to the possibility of the Swedish legislative framework surrounding BESS/BaaS solutions becoming stricter, adding additional challenges and costs to market entrants.

Thirdly, some *operational bottlenecks* are currently hindering the optimal development of BESS applications. In particular, timelines for battery storage project deployment are presently estimated to be as long as one to two years, due to battery procurement issues as well as significant wait time for DSOs/TSOs' approvals.

Furthermore, software issues were found to be a key operational issue for various interviewees. At present, suppliers typically provide a basic Battery Management System (BMS) alongside their batteries. Still, the consensus amongst interviewees was that

these BMSs usually only ensure everyday battery operations and are too limited to support applications such as frequency regulation. As a consequence, additional software is required on top of the BMS for optimal battery application. This itself can lead to important integration challenges with other parts of an electric system, leading to significant costs. This specifically hinders smaller players purchasing smaller BESSs, as the size of their battery storage may not justify the costs associated with it.

This last challenge can, in our view, equally be handled as a market gap opportunity by a market entrant such as Volvo AB. Given the lack of standardisation in the BMS space and the need for costly, individualised solutions, a BESS or BaaS market entrant with a more developed BMS offering with sophisticated applications could differentiate itself in a profound way with end-user groups.

A summary of findings related to operational aspects and market conditions can be found below.

Figure 5: Summary of the project's findings related to operational aspects and market conditions

Key Actors	TSOs	Approval for FCR market participation
	DSOs	Approval for grid connection of BESS, development of subsidiary energy companies with potential of being competitors or partners
	Aggregator	Can be internal or external, acts as a middleman. Potential knowledge partner
Challenges	Profitability Challenges	Market saturation, Region's electricity context, Regulatory framework
	Operational Challenges	Approval and supply chain delays. Lack of standard BMS and need for advanced EMS
Market Opportunities		Demand for BESS, Proved Business case (stacking services), Funding availability

## Recommendations

Based on the above results outlined in two parts, we have summarised our recommendations to Volvo AB regarding a potential entry into the BaaS market in the following way.

### *Stacking services*

To overcome the challenge of uncertainty around market saturation and to build a stronger long-term business case, so-called ‘service stacking’ is advisable. This refers to the practice of practicing multiple BESS

applications at the same time- such as combining peak shaving and load shifting with energy arbitrage at the same time. Service stacking proved to be crucial to the profitability of some studied use-cases.

### *Consider Bundling End-Users*

Some BESS/BaaS use-cases demonstrate the importance of looking beyond a company’s organisational boundaries, to bundle multiple end-users together instead.

This was observed, for instance, in an industrial region where multiple neighbouring end-users can benefit from the BESS, and even share on-site renewable energy generation. Another example that was studied established microgrids in municipalities and supported companies and households.

### *Partnerships*

A key theme throughout our findings has been the importance of establishing partnerships in the BESS/BaaS space.

*Technology partnerships* were found to be prevalent for the BMS market gap identified above: in particular with software providers, IoT suppliers, and data system providers.

*Energy partnerships* with solar energy providers, or photovoltaic solar cells

manufacturers may enable on-site renewable energy in conjunction with the BESS or BaaS offering.

*End of Life partnerships* have been observed in existing cases to be able to recycle important minerals from the batteries, leading to potential further value-adds.

*Financial partnerships* were observed to be crucial to a BaaS given the payment considerations of end-users which were outlined in the results section. In our view, this represents a potential strong market advantage for Volvo AB, given its established Volvo Financial Services area.

*Knowledge partnerships* related to how the BESS/BaaS space operates may be paramount to new market entrants- DSOs and Aggregators, in addition to being necessary partners for operational processes, are the ideal candidates given their experience in the industry.

## Reflections

This section summarises some of the key personal learnings the team members have retained, as three future sustainability professionals.

### *External learnings*

Our project’s Step 4 – Interviews was particularly educational. Chiefly, the relevance of BESS as a topic became obvious to us through our interactions with multiple stakeholders in the Swedish electricity value chain. Various of our leads responded enthusiastically to our outreach based on the importance of the subject matter, and we observed a consensus that BESS applications and subsequent demand would grow in Sweden. We identified multiple circumstances for BESS being a ‘hot topic’ in the

industry- such as the rise of electricity prices, current geopolitics, and increasing electricity demand challenging the stability of the Swedish electricity grid. Interestingly, though, we observed that *positive views related to BESS could still differ in fundamental ways*. For example, some respondents were confident in BESSs' ability to address crucial future shortcomings in the Swedish electricity grid, especially related to grid stability needs in the face of rising intermittent energy sources. Others, by contrast, highlighted that BESS could only be a 'side-solution' to energy challenges, but would never be able to address questions such as seasonal energy storage.

### *Internal learnings*

One of the underlying aims of our 5-step methodological process was to address some of the challenges we had identified with our project from the outset. We looked to address its highly technical nature through our Step 1 - Knowledge Building; and our lack of existing network through a 'mass outreach' approach in Step 3 – Outreach.

In hindsight, our approach proved to be mostly sound and aided us as the project unravelled- in particular with regards to our outreach step, where we effectively hit a response rate of about 20%. Had we used a more qualitative strategy and approached a much lower number of leads, we would have most likely not been able to conduct a total of 16 interviews. Of course, on the flipside, this meant a less precise and targeted lead outreach, which could mean that we have omitted some obvious end-users or actors. That being said, given time constraints, we feel mostly satisfied with this trade-off. In addition to this, it became apparent to us that a project with high uncertainty and knowledge gaps meant that, although our methodology was mostly iterative, an

element of non-linearity was necessary. For example, while our Step 1 – Knowledge Bases provided us with a solid technical foundation, new key learnings were acquired continuously throughout our project. In particular, the new information we learned through our interviews meant a refining of our Step 2 – Stakeholder Mapping, which itself meant revisiting our outreach list in Step 3, and potentially rewriting some of our interview questions in Step 4. This had to be accompanied with sustained communication between team members and with our supervisor.

## **Conclusion**

Although limited in scope, our findings throughout this project have pointed to the BESS market being a dynamic and growing field, with exciting potential applications related to as-a-service offerings. This represents an interesting opportunity for an established multinational such as Volvo AB, looking to drive its sustainable transition in the most innovative way possible.

At the same time, our four weeks of research have shown time and time again the complexity of this space. In particular, the variety in not only end-user applications but also types of stakeholders present in BESS processes became very apparent. This, we feel, has an important implication for Volvo Energy: to continue to gather enough information on the BESS space- both in terms of actors and end-user profiles – in order to penetrate this market successfully.

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## Annex

### List of interviewees

- Internal Volvo AB employee: 13/10/2022
- Production Manager at Swedish sawmill company: 14/10/2022
- Director at a Swedish multinational metals and mining company: 17/10/2022
- Head of innovation at a Swedish city port: 17/10/2022
- Representative at a Swedish healthcare company: 18/10/2022
- Product Manager at a Swedish aggregator: 18/10/2022
- Product Lead at a Swedish electric utility company: 19/10/2022
- Project Leader at a Skåne municipality: 20/10/2022
- Product Manager at a Swedish electric utility company: 20/10/2022
- Manager at a Swedish dairy farm: 20/10/2022
- Manager at a Swedish electric utility company: 20/10/2022
- Manager at a Swedish aggregator: 20/10/2022
- CEO at a Swedish city port: 24/10/2022
- Head of Critical Infrastructure at a multinational Hotel Group: 24/10/2022
- Manager at a Swedish electric utility company: 24/10/2022





# **Circularity in The Shipping Industry**

# Circularity in the Shipping Industry

## Exploring the landscape and pathways of closing the steel loop

*By Martine Deinum, Bianca Terrero Vega, Ziyue Wang and Tim Ziegler*



From left to right: Martine, Ziyue, Tim and Bianca

### Acknowledgements

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We also want to thank Lars Strupeit, our supervisor and travel agent, for giving us valuable feedback and for making the trip to Rotterdam a reality.

Last but not least, thank you to our course coordinator Håkan Rodhe for providing us opportunities to exchange thoughts and

learn from our peers, and our fellow EMPers for lending your ears to our problems and providing great advice.

### The Team

Martine Deinum is a Dutch Canadian with experience in environmental project evaluation and a passion for oceanic conservation. In her free time she is involved in food waste reduction activities. Her favorite ocean creature is the humpback whale.

Bianca Terrero Vega is from the Dominican Republic, where she worked in the mining sector on logistics and EMS, leading to her passion for fighting resource scarcity. She is also involved in the Dominican music and film scene. Her favorite maritime animal is the manatee.

Ziyue Wang is from China. With a background in law and experience in environmental communication, she is passionate about lowering our environmental impact on planet Earth and coexisting with other species in peace. She holds a FASCINATION with the hammerhead shark.

Tim Ziegler is a mobile sea urchin feeling at home wherever he is located. He has a background in kitesurfing and climbing, and although he likes dizzy heights, falling down the cliff of human arbitrariness is not an option for him. He attempts to be a climate optimist because pessimism means losing one's meaning of life.

## The Shipping Landscape

In 2018, global shipping generated over 1000 million tonnes of CO<sub>2</sub> - the equivalent to nearly 3% of global annual emissions caused by human activities. Climate change is one of the most pressing issues of our time, threatening the existence of humankind. Rising sea levels and extreme weather events also pose new challenges for the shipping.

Nevertheless, the transportation of goods by sea is demanded more than ever, since it is one of the most energy-efficient modes of transportation. As a result, the global shipping industry is expected to grow annually by 2.4%. The enormous growth potential can undermine the ambitions of the Paris Agreement, which the shipping industry is not directly party to due to its global nature.

A ship's life cycle is often described as a 'cradle-to-grave' approach. As shown in *Figure 1*, this includes three phases: production, use, and end-of-life (EOL). Commercial ships are primarily produced in three East Asian countries: China, South Korea, and Japan.

They dominate the market by building over 90% of the world's merchant vessels. During the use phase, those vessels transport more than 80% of all goods in volume across the globe. Basically, whatever we own or consume was shipped.

Importantly, the operational phase accounts for around 95% of total CO<sub>2</sub> emissions of a ship.

However, like every product, ships have a limited timespan - usually ranging between 20 to 30 years. The dismantling - or recycling - of ships mainly takes place in South Asia. India, Bangladesh and Pakistan recycle around 84% of all decommissioned ships in volume. Although the impact of the use phase on climate change is staggering, the production and EOL phases cannot be neglected. The largest share of production and EOL emissions are generated by the production and recycling of steel, since a vessel consists of 70% to 80% steel.

The recycling of a ship's scrap steel for building new ships is one of the solutions to reduce the shipping's environmental footprint beyond the use phase. However, the geographical mismatch of the production and EOL stages lead to a geographically fragmented value chain. The pressing question is: 'How to close the steel loop to improve circularity within the shipping industry?'

### Approaches to Circularity

The exemption from the Paris Agreement and absence of stringent international regulations require shipping organizations to take initiative in order to reduce their total emissions. One prime example is the Sustainable Shipping Initiative (SSI). The SSI, a multi-stakeholder initiative of

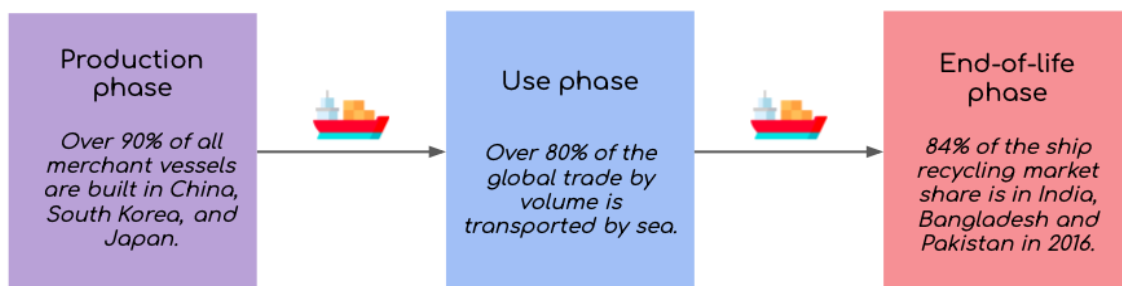


Figure 1: The 'cradle-to-grave' approach of merchant vessels in the shipping industry

ambitious maritime leaders in the shipping industry, explores the industry’s transition to circularity across all life stages of a ship. Circular business models have the potential to contribute to a more sustainable and efficient world while reducing the total environmental footprint.

The circulation of ships’ scrap steel within the shipping industry would introduce several benefits but also bear enormous challenges. The benefits include a reduction of the industry’s CO2 emissions in the production and EOL phases and lower extraction rates of virgin materials to build new ships. There are other factors to consider however. Currently, scrap steel from dismantled ships is primarily reused or recycled for other purposes such as construction in the local economies of shipbreaking countries. For instance, in Bangladesh the ship recycling industry contributes around 71% of ferrous scrap required by the domestic steel industry. The challenges and drivers will be further discussed in the following section.

**Objectives**

This research contributes to the efforts of the SSI by exploring the different perspectives of circularity as well as the option of closing the loop and keeping recycled ship steel within the shipping industry. The objectives of the research project are threefold:

1. Identify the main actors of the steel and shipping industries, which must be considered in order to close the physical loop of steel.
2. Map the flow of steel in the value chain of a ship’s lifecycle.
3. Explore potential drivers and barriers which can either enable or impede the goal of closing the physical loop of steel in the shipping industry.

**Methodology**

Qualitative analysis was conducted through two main methods: desktop research and stakeholder interviews. Each method

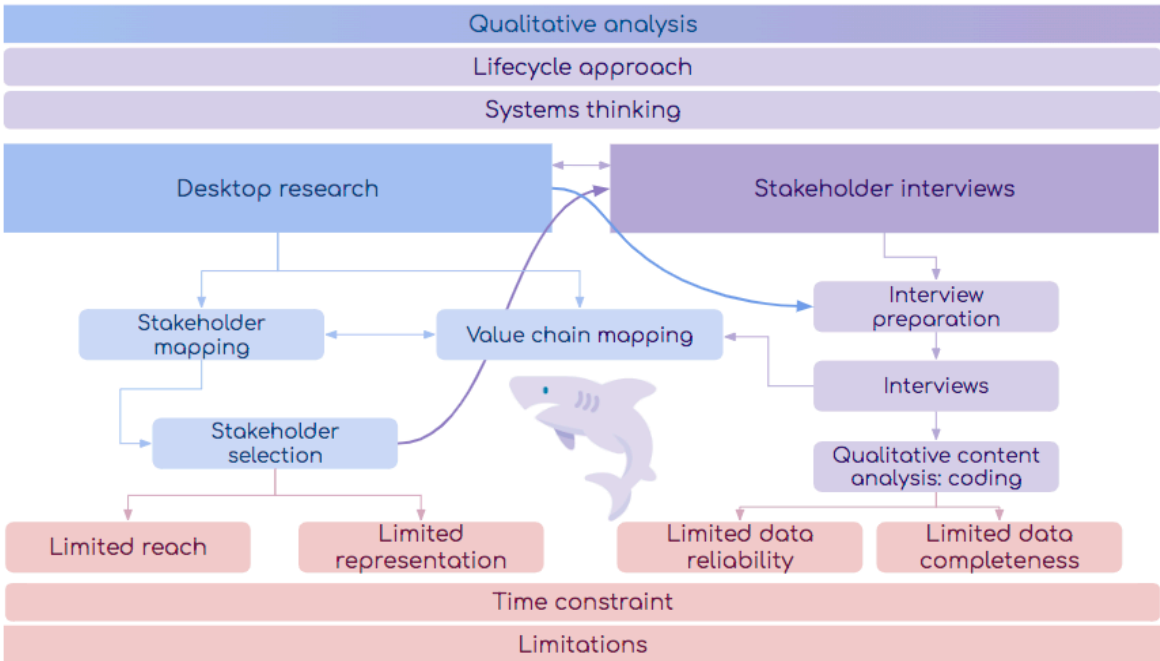


Figure 2: Visual roadmap of the methodology applied



consists of several steps, as shown in *Figure 2*. The project started with extensive desktop research, consisting primarily of a literature review based on existing research to assist the recognition of the shipping landscape and value chain, to further identify key stakeholders, and to prioritize the most relevant information to be gained from the interviews.

The primary data collection method chosen in this project was stakeholder interviews. By asking open-ended questions, the researchers aimed to gain a diversity of stakeholder insights and up-to-date information from the frontline of the industry.

### Analysis & Results

#### Mapping the Value Chain

Mapping the value chain of the life cycle of steel has been the core element of this project, providing an overview of the main lifecycle stages, the stakeholders involved, and the various connections and complexities between them. This map provides the SSI with an outsider's

perspective of the value chain - a perspective which can be restricted by stakeholders who are focusing on one specific part of the chain. Throughout the course of this project, the value chain map was continuously improved and edited in response to new information and perspectives from stakeholders.

The lifecycle stages of steel identified in *Figure 3* - production (purple), use (blue), and EOL (coral) - have been found to interconnect with and depend on various other actors within the system. The arrows signify interactions, and vary between material flows, information dissemination, transactions, and regulatory oversight. Defining the exact type and nature of the flows was outside the scope of this project, as it requires the engagement of a wider representation of stakeholders; hence the arrows simply define interactions. By highlighting commonly overlooked actors and their interactions, the industry can be better understood and the activities and stakeholders relevant to closing the steel loop can be more clearly identified.

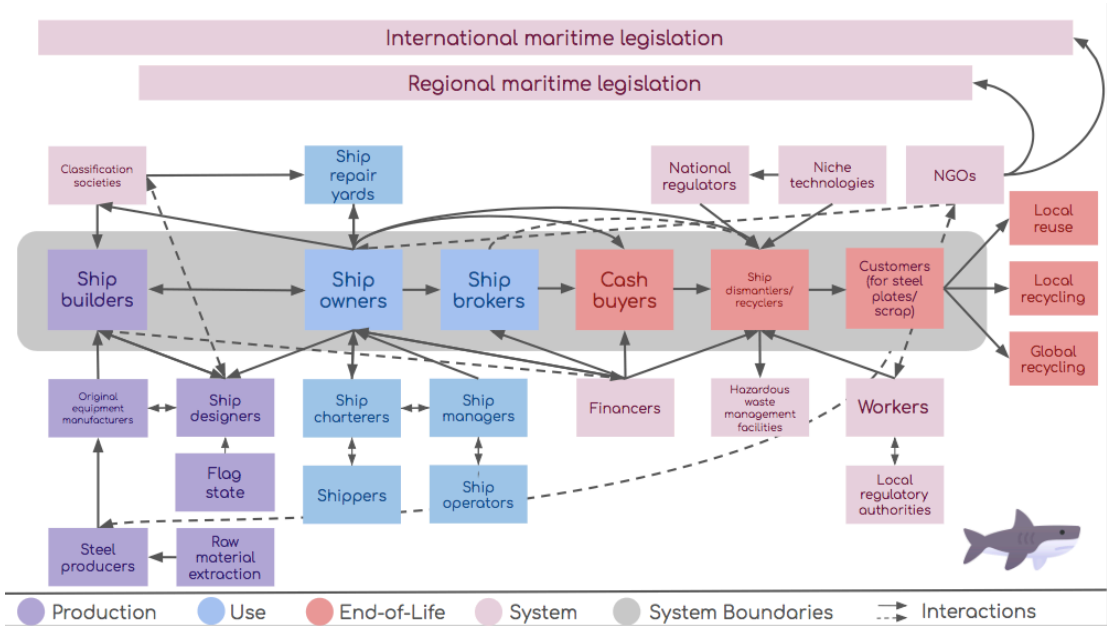


Figure 3: Value chain of steel in the shipping industry

### How does the shipping industry define circularity?

A clear and unambiguous definition of the term ‘circularity’ within the shipping industry is key for the transition to a circular industry. Most research and stakeholder views indicated that the industry is seeking to create a closed loop for the material flow of steel. This is embedded in the idea of a ‘cradle-to-cradle’ framework which proposes that all components of a product should feed into the making of another product. However, it became evident throughout the research process that “closing the steel loop” entails different meanings - as shown in *Figure 4*.

On one hand, the loop is defined as a closed physical loop in which steel circulates solely through the life stages of a ship. This implies that after a ship is dismantled, the scrap steel is fed into the production of newly built ships. Whereas another widely established narrative is that of a closed general loop, which follows the general flow of steel and does not exclude its utilization in other industries, including construction and road-building.

### What are the challenges and drivers for closing the physical loop?

There are a number of factors enabling and hindering steel circularity within the shipping industry. *Figure 5* lists the main challenges and drivers, and the following paragraphs will expand on the main points.

#### Key Challenges

##### Low profit margins

Although low profit margins themselves are not necessarily a challenge, the associated impacts are. Low profit margins have manifested as high competitiveness in the shipping industry, which negatively impacts information sharing and collaboration. This in turn slows innovation and progress towards more sustainable practices.

Low profit margins also fuel the profit-drivenness of the industry. Given that the price for scrap steel in South Asia is drastically higher than in other parts of the world, shipowners and cash buyers are more likely to choose shipyards located in this region as they will receive more value for their vessels. This poses a challenge as the majority of shipbuilding happens in South Asia, and the possibility of moving a share of the dismantling industry to areas of the world where shipbuilding takes place is economically disincentivized.

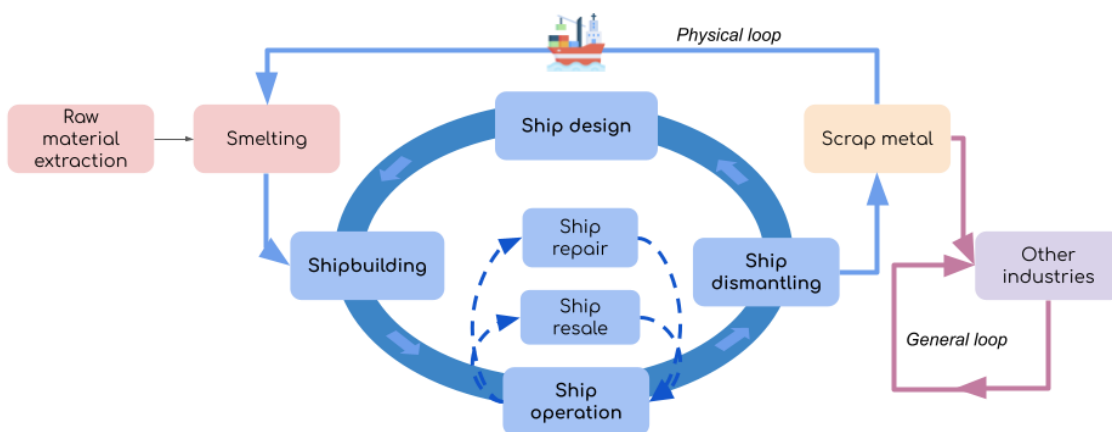


Figure 4: Different circularity narratives: the general and physical closed loops

### *Geographical distribution of activities*

Aside from regional price differences creating a challenge to circularity, the geographical distribution of value chain activities also creates other practical and economic barriers. For shipbuilding countries, it is more feasible to use virgin iron ore rather than importing scrap steel from South Asia, remanufacturing it, and reintegrating it into the shipbuilding industry.

EOL approaches also differ based on geographical context: European ship dismantling companies generally focus on scrapping the ship’s steel rather than reusing or re-rolling it, whereas in South Asia, the latter two are more prevalent. The different approaches challenge the premise of closing the steel loop, as it relies on scrapping and re-smelting - processes which dominant ship dismantling nations do not focus on.

### *Poor traceability over a ship’s lifespan*

The long lifespan of ships can present a technical challenge. A vessel often has frequent exchanges of operators and

multiple ship owners, resulting in low traceability, which makes it difficult to predict, plan or control the EOL treatment. Without clear oversight over the metrics of the EOL phase, planning for circularity becomes more difficult.

### **Key Drivers for Closing the Physical Loop**

#### *Financial sector lending standards*

Financial institutions providing loans to shipbuilding companies, along with other shipping industry actors, have introduced the Poseidon Principles, a framework for integrating climate-related factors into lending decisions. The principles require loan-takers to measure greenhouse gas (GHG) emissions and determine whether their emissions match the trajectory required to meet the International Maritime Organization’s (IMO) goal, indirectly encouraging the integration of circulatory practices which can decrease GHG emissions.

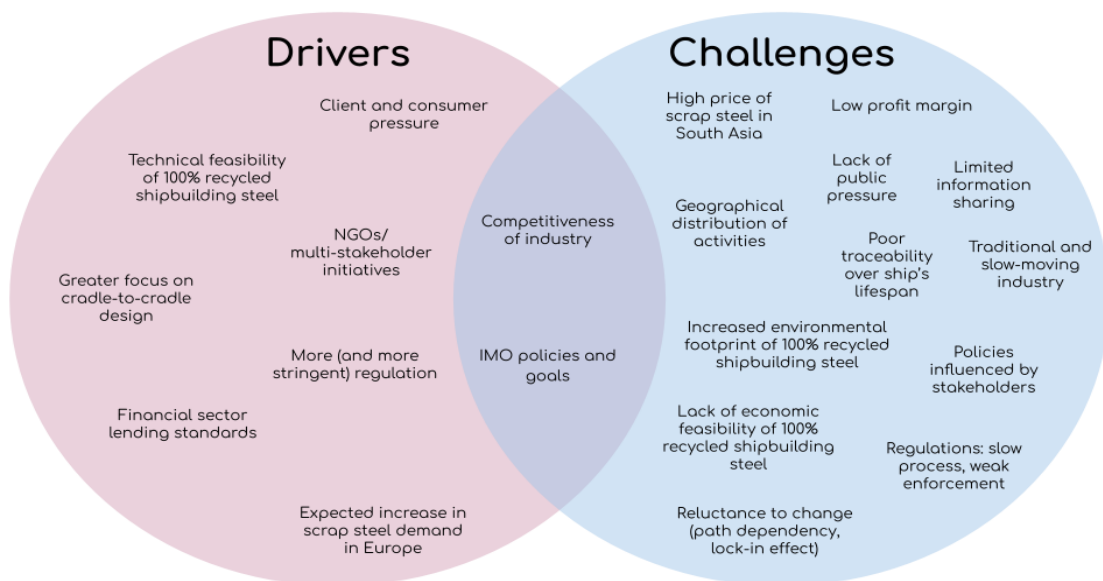


Figure 5: Drivers and challenges for closing the physical loop

### IMO policies and goals

Since the IMO released its initial GHG strategy in 2018, which sets the goal for 50% emissions reduction by 2050, there has been progress towards creating measures to meet this target. Through this, the IMO is setting the sustainability narrative for the shipping industry.

of scrap steel, an interviewee explained that Europe is expected to become a net importer, and high-quality shipbuilding steel scrap could be viewed as a premium product.

### What are the implications of closing the steel loop?

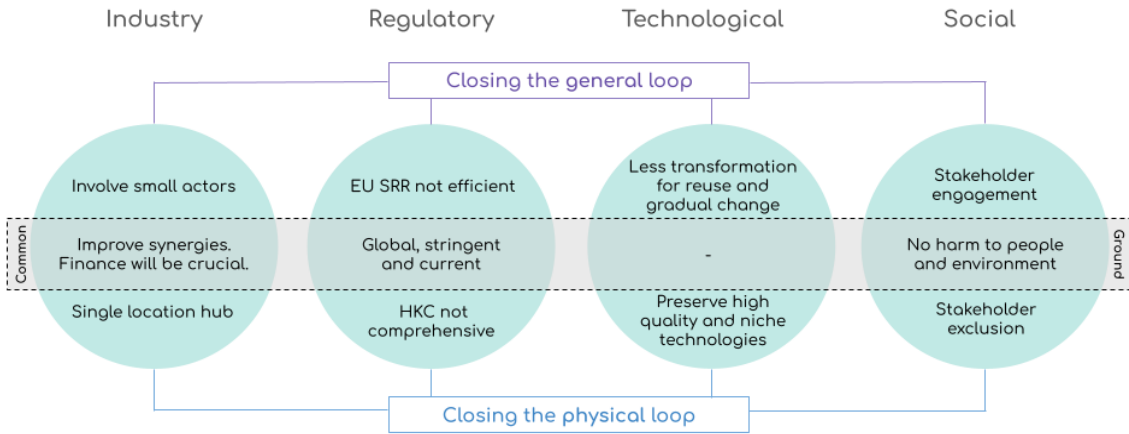


Figure 6: Implications of closing the steel loop

The IMO’s 2050 goal is also a driver for circularity by increasing demand for recycling operations. Since some ships will be recycled sooner due to outdated technology, there may be a greater focus on cradle-to-cradle design. This could also translate into more upgradable vessels, improving circular design. It is worth noting that earlier retirement of ships would have a negative impact on lifespan and corresponding value chain emissions, however.

### Market pressures & trends

Although the invisibility of the shipping industry decreases public pressure, direct clients and customers of the shipping industry are demanding sustainability reporting and efforts to decrease emissions.

The scrap steel demand in Europe is also a driver for circularity within Europe. Although Europe is currently a net exporter

Through the interviews and literature review, potential implications of closing the steel loop were identified and categorized. Figure 6 illustrates how the implications vary depending on whether they are pursuing a closed ‘physical’ or ‘general’ loop, and also where commonalities exist.

**Industry implications:** Those favoring the closure of the ‘physical’ loop highlighted the importance of establishing hubs, where the production and EOL stages of a ship are carried out at the same site, and material from the EOL stage can loop back to production more easily. This hub concept has been envisioned within the European Union, however literature and interviews favoring the ‘general’ loop signaled that the upcoming surge of ships reaching their EOL cannot be met without the dismantling capacity of India, Bangladesh, and Pakistan.

**Regulatory implications:** Regional policies, such as the EU SRR, are not



enough to tackle the international issues of the shipping industry. In addition, its approval process for recycling facilities has been deemed slow-going. The HKC is perceived to address health and safety rather than sustainability aspects, thus its anticipated approval alone is also not expected to address circularity. The consensus is that there is a need for a global policy that is purposefully drafted for the responsible treatment of EOL ships.

**Technological implications:** When it comes to closing the physical loop, the main priority is to preserve the highest quality of steel possible in order to comply with the requirements of marine-grade steel used for shipbuilding. New technologies that seek to ensure this often come with increased automatization which also reduces time and labor inputs. However, taking the human factor out of ship dismantling yields more steel scrap than manually cutting readily reusable steel slates, but scrap steel requires more processing to circulate it back into the steel loop. Additionally, interviewees pointed out that technological change in South Asia should be gradual, manageable by workers, and affordable for shipyards, such as the introduction of cranes and impermeable flooring as improvement for beaching practices.

**Social implications:** The approach of closing the physical steel loop and creating circularity hubs, as envisioned by some interviewees, would entail a transfer of the ship dismantling industry from South Asia to Europe. This transition would reduce employment sources in South Asian shipbreaking countries and hinder the supply of steel to local industries. Advocates of this vision view these social implications as a compromise that should be addressed by local governments. The opinion of

interviewees that support the closed 'general' loop however, is that South Asia's current dependency on ship dismantling and the conditions in which it happens - such as unmitigated beaching - were established under the influence and in full awareness of the shipping sector. Supporters of this perspective advocate increasing engagement with South Asian stakeholders that have shown willingness to improve their practices, instead of excluding them from new developments in the industry.

## Recommendations

### *Stakeholder representation & engagement*

#### **Increase stakeholder representation**

Despite the coverage of stakeholder groups in this project, the proportional representation of stakeholders should be improved in future studies. Stakeholders such as ship owners have numerous interactions with almost every industry actor, thus should be more widely interviewed and considered.

Furthermore, due to the limited involvement of stakeholders from geographically relevant locations, it is recommended that future research focus on communications with stakeholders from South and East Asian countries. It is important to receive input from these stakeholders as they represent the largest market shares in ship dismantling and shipbuilding.

#### **Improve stakeholder inclusion**

The number of stakeholder groups involved in the life cycle of steel in shipping is considerably high. Due to this large value chain, some stakeholders such as ship

original equipment manufacturers and steel mills were overlooked in the research process and the interviews. It is vital that as the SSI moves forward with this project that engagement with stakeholders goes beyond the three main actors - shipbuilders, owners and dismantlers. This leads to a better understanding of the leading narratives surrounding steel circularity and the reasoning behind them.

Through the interviews, it became clear that stakeholders must not only be better represented, but also better included. Despite being part of the SSI, some stakeholders were reluctant to engage. Although this project did not allow the time to work on establishing better communication methods with these stakeholders, active engagement should be a priority as the SSI moves forward with the steel circularity project. Understanding cultural differences in communication expectations (e.g., communication channels, formalities, writing format, and language use), as well as engaging with translating services, could improve the inclusion of more stakeholders.

### **Share information among stakeholders**

The SSI has the valuable position to use its platform to bring together industry stakeholders and disseminate knowledge on steel circulatory through, for example, information briefs, workshops, and conferences.

An online clearinghouse (i.e., a one-stop shop for information and case examples) can also be created to facilitate information sharing.

Stakeholder engagements should be designed to find common ground in progressing circular practices and

processes, in order to identify commonalities and synergies which most - if not all - stakeholders share.

### *Innovation*

#### **Promote the use of material passports**

Despite the proposal of introducing a material passport, there are still efforts needed to bring it to reality. For instance, classification societies need the authority to implement and enforce a material passport system to trace the material flow of steel. Simultaneously, ship owners should demand material passports from shipbuilders and designers, while ship dismantlers should request the same from ship owners.

Through a frontrunner approach - where industry leaders mobilize change by setting industry standards - rather than waiting for regulations to require material tracing, the issue of traceability can be more efficiently addressed.

#### **Invest in innovative business models**

Leasing ships over a certain period of time is an upcoming business strategy to increase the traceability of ships throughout their use phase. This tracking method allows shipowners to take ships back before they reach their EOL. However, a network of global partnerships is necessary to maintain the viability of the business model; a global grid of operational facilities would increase the flexibility and reach of the leasing model.

It would also be beneficial to explore the concept of extended producer responsibility through reuse and refurbishing with original equipment manufacturers. One way to implement this is to develop take-back systems for parts and machinery.

## **Slow the steel loop in shipping**

This concept implies prolonging the use phase of vessels. In the context of closing the loop, slowing the loop is easily neglected. However, interviewees have pointed out its importance and potential to improve resource efficiency through extending the lifespan of ships. This can be achieved in two ways. First, a ship must be designed in such a way that the durability, longevity, and modularity of ships is improved. Second, continuous maintenance, proper repairs, and retrofitting can substantially extend the lifetime of a ship. It is recommended that the SSI consider the concept of slowing the loop in conjunction with closing the loop.

### *Improved Data Collection, Processing and Analysis*

## **Follow the flow of steel**

Since shipping is a transnational undertaking, mapping out materials flows such as steel can be complicated. Input-output analyses are a useful tool to study not only the economic activities of a company but also of countries and/or regions. This top-down approach quantifies the flow of materials, which can determine the feasibility of circularity approaches.

## **Compare the alternatives**

Assessing the environmental impact of different circularity approaches can best be solved by conducting a context-dependent life cycle assessment (LCA). This bottom-up approach should be applied to determine whether it is environmentally justifiable to close the steel loop in specific situations. For example, using recycled steel from a steel mill in India for a ship being built in China versus using virgin steel from a mill in China.

## **Expand research topics**

Due to the limited time allocated to research and data acquisition in this project, it is recommended that research be furthered in the areas of:

- The carbon accounting scheme for shipbuilding sector to explore its impact on the choosing of building materials;
- Regulations that can promote or discourage the circular use of steel in the shipbuilding industry.

Additionally, due to the limited exposure to stakeholders, this paper does not accurately represent every perspective of the industry. It is recommended that more interviews take place, and more stakeholders with distinctive expertise should be consulted to validate and broaden the findings of this research.

## **Conclusion**

The integral role of background research and industry knowledge in order to grasp the scope of the project and understand the perspectives of different stakeholders should not be underestimated. Despite certain sectors being less engaged in the SSI, their perspectives should not be overlooked. A successful outcome to circularity initiatives within the SSI requires the engagement of the full value chain.

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**Facing Waste Management  
Challenges through Global  
Cooperation**



*From left to right: Patricia, André, Marie, Emilia*

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## The Team

**Emilia** is from Chile and holds a professional degree in Business and

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**Patricia** is from Ghana and holds a B.A. in Economics from KNUST, Ghana. Her experience is in plastic waste management and she worked for 3 years as a Project Officer for an NGO and a Manager of a recycling plant. She has an interest in driving circularity efforts in developing countries.

**André** is from Switzerland and holds a BBA and completed an MSc in Logistics and Supply Chain Management at Cranfield University. He was managing global supply chains for five years before coming to the IIIEE.

# Facing Waste Management Challenges Through Global Cooperation:

## A Clearinghouse initiative between UNDP and Avfall Sverige

*By Patricia Agyare, Marie Gomersall, Emilia Paredes, André Wismer*

### Introduction

Population growth, booming economies, rapid urbanisation, among other factors, have greatly accelerated global solid waste generation [1]. Inadequate waste management has several serious consequences and affects health, climate, the environment and other aspects of modern life [2]. As such, waste management has become one of the top priorities of many governments. Many of these governments, especially those in the Global South, however, lack the resources and the capacity to manage this situation sustainably.

Consequently, the United Nations Development Programme (UNDP), receives a high number of requests from these countries on how to manage their waste adequately. There is a need for knowledge and experience sharing from countries already doing well in terms of waste management such as Sweden - a pioneer in adequate waste management. Avfall Sverige is the Swedish Municipal Waste Management and Recycling Association that gathers all Swedish municipalities in national and international activities to promote zero waste vision and strategies.

As part of UNDP's work to support waste management among its 170 partner countries through the sharing of knowledge and

experience from the Global North, the UNDP and Avfall Sverige have agreed to partner in establishing a global centre of excellence for waste management. This initiative, which they currently term as the waste clearinghouse, has the goal of serving as a one-stop shop to handle questions on waste management channelled through the UNDP system. The scope is broad and aims to provide policy, technical, and program advice to municipalities with respect to urban infrastructure development, finance, governance, awareness, education and training in waste management, all with a view of increasing equality and inclusiveness.

UNDP and Avfall Sverige signed a Memorandum of Understanding (MOU) in December 2021 and a Terms of Reference (TOR) document has been drafted to formalise the cooperation.

### Clients and Task

For this consultancy project, our clients are the internal actors developing and overseeing the clearinghouse initiative, herein representatives from the United Nations Development Programme (UNDP) and Avfall Sverige.

Our task was to review the current proposal for the waste management clearinghouse and provide inputs that can guide internal

actors on how to make it a more robust and actionable initiative. Along with the client, it was decided that the main source of inputs for this objective would come through learning from the perspective of selected stakeholders that are expected to interact with the clearinghouse, and could share their experiences and suggestions for the most relevant aspects. Furthermore, we reviewed other existing initiatives, as a source of information to create a general overview of a larger ecosystem of global initiatives that may be relevant for a waste management clearinghouse.

### Methodology

The work carried out during the project can be divided into three phases, outlined in figure 1. Each phase included a combination of desktop research, interviews, and systematic content analysis.

From phase 1, six key themes- showcased in figure 2- were identified to guide the information collection, analysis process, and presentation of findings. Guiding questions in Figure 2 convey the meaning of each theme, although the goal was not to provide final answers to these questions specifically, but to guide the clients in a more robust and actionable direction.

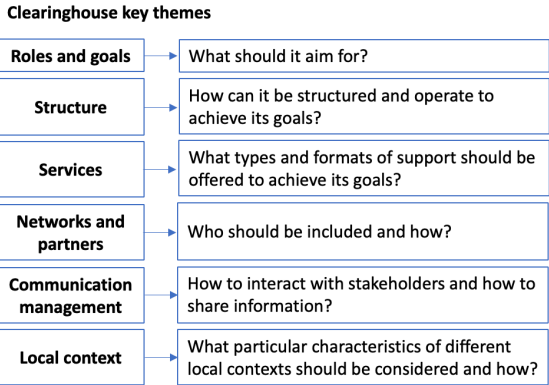


Figure 2. Clearinghouse key themes guiding project

Regarding phase two, the approaches presented in figure 1 are connected as three interviewees were representatives of “other initiatives”. The interviews’ goal was to discuss with the interviewees their perspectives and ideas regarding the key themes. For this, a common interview framework was developed based on these themes and a literature review [1], [2]. Figure 3 presents the type and number of stakeholders involved. The selected interviewees represent both what was defined as the “demand side” (i.e. those that could request support from the clearinghouse or could channel others’ requests) and the “support side” (i.e. those that could be approached by the clearinghouse to provide expertise).

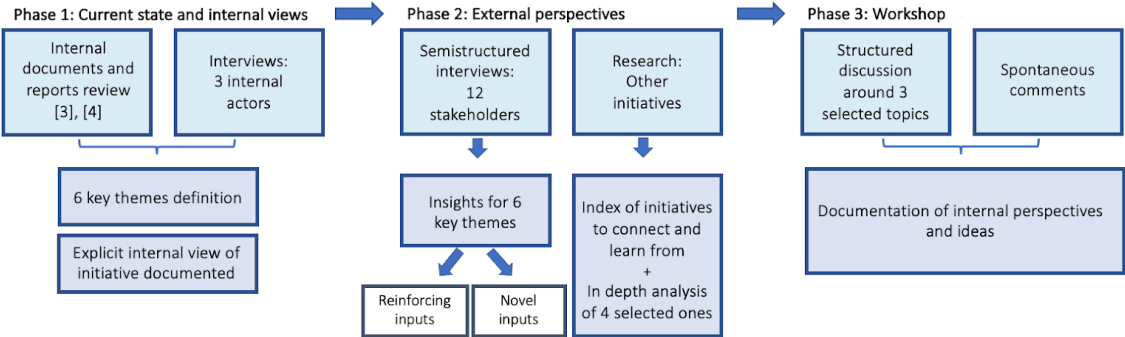


Figure 1. Methodological phases



For each theme explored, stakeholders’ insights were classified as “reinforcing inputs” (i.e. validating the clients’ vision), or as “novel inputs” (i.e. adding new perspectives to the clients’ vision or making certain issues explicit). The selected initiatives mentioned in in phase 2 of Figure 1 were selected due to their similarities in focus (i.e. waste management issues) and/or in their approaches (i.e. type of goals, services provided, structure, etc.), which makes them well-suited to use as references.

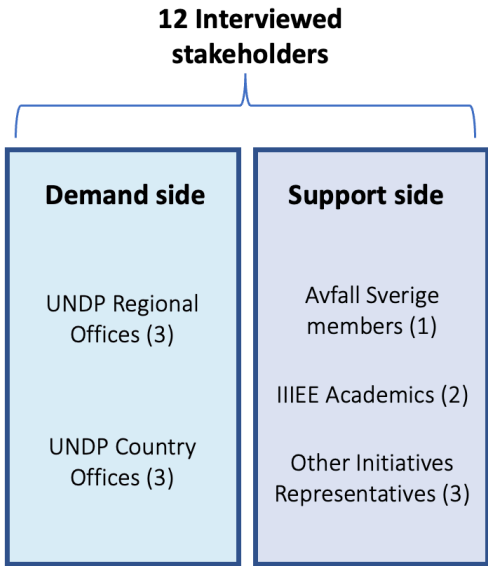


Figure 3. Interviewed stakeholders categorisation

### Clients Vision

This section points out the current understanding of the various themes of the initiative by the internal actors as stated in the internal documents (Memorandum of Understanding and Terms of Reference) and the interview insights with the internal actors.

Figure 3. Interviewed stakeholders categorisation

tive by the internal actors as stated in the internal documents (Memorandum of Understanding and Terms of Reference) and the interview insights with the internal actors.

### Roles and Goals

The primary goal of the clearinghouse initiative is to stabilise the present waste situation globally and develop a zero-waste

vision aiming at circularity. With this overarching goal, the roles of the clearinghouse include:

- Provision of policy, technical and program advisory services to municipalities concerning the infrastructure development, finance and governance in waste management
- Support for education, awareness, capacity building and training in waste management
- Knowledge and experience sharing through organising and sharing information
- Networking and facilitating partnerships
- Facilitating South-South exchanges and cooperation
- Guiding and answering questions related to waste management

### Structure

Internal actors and documents outline that the clearinghouse should be set up as a subdivision within Avfall Sverige, creating a flexible organisation governed by a steering committee. Internal staff would not exceed three full-time employees, as those supporting the provision of services would be external experts and partners collaborating on a contractual basis. Moreover, IT, financial and administrative support would be obtained through Avfall Sverige.

The work would be launched through selected pilot projects, which would further guide the definition of its structure, goals and services.

Currently, internal work has greatly focussed on funding for the clearinghouse, which has been identified as a key element to be clarified in order to move forward with the initiative.

## *Services*

The listed potential services in the internal documents are well aligned with the roles of the clearinghouse stated above. Some other specific services mentioned in these documents and elaborated on by the internal actors include offering programme and operational support, providing training and institutional strengthening, organising legal and financing steering instruments, assisting in creating waste associations and sustainable business models, and promoting collaborative governance structures, as well as serving as a one-stop shop to addressing questions and project ideas on waste management.

## *Communication Management*

Currently no concrete strategies have been included in the documents, nevertheless internal actors mentioned several ideas in the interviews. First, they expect UNDP Country Officers to serve as mediators, channeling and responding to requests from local actors, though local actors could also reach directly if channels allow for it. Likewise, the plan is to use existing channels in the local context to disseminate knowledge, both those developed by UNDP and any other relevant communication systems.

Furthermore, it is worth noting that for information dissemination, expectations from internal actors can be encompassed in three formats: (1) developing and showcasing informational “toolboxes” and other products, (2) responding to requests by directing to the aforementioned toolboxes and products, and (3) providing more personalised responses for specific cases. Regarding these first two formats, while not very explicit, it is understood that a one-stop shop digital platform would be considered.

## *Network and Partners*

A broad structure of partners has been outlined in internal documents and further elaborated in conversations with internal actors, though a specific network system remains fairly open. From the demand side, the main actors would be UNDP Country Officers and representatives of national or local governments, with a special emphasis on municipalities. From the supportive side, municipal members of Avfall Sverige will be the main actors, but support could be sourced elsewhere. Other actors within the UN, other international cooperation organisations, sponsoring organisations, and academia have all been considered.

## *Local Context*

The need to understand and adapt to the local context is considered a key success factor by the authors of the initial proposal. They acknowledge that waste conditions and governance differ in various countries and as such there is no one-size-fits-all solution.

## **External Stakeholders Inputs**

The following sections will divide the key insights of our interviews as per the same six themes presented above. While the former section focuses on the inputs from internal actors, the following findings stem from our twelve external interviews, and categorises findings in either reinforcing or novel inputs.

### *Roles and Goals*

#### *Reinforcing inputs*

Most of the interview insights in this theme highly correspond to the Clients’ vision of the initiative. For instance, actors from the demand side acknowledged that UNDP receives requests for help concerning waste management from municipalities in the

Global South. Hence, they envision the clearinghouse providing answers, advice and support to the diverse waste management problems they face. They also envisage that the clearinghouse will be a platform to share knowledge and experience. Due to the differences in contexts, some also mentioned that the clearinghouse could provide value by facilitating more South to South exchanges and cooperation.

#### Novel inputs

**Complexities:** Addressing technology and governance aspects were considered to be more complex by an academic expert compared to organising information and inviting people to the clearinghouse's network.

**Realistic expectations:** It is seen as important to ensure that local actors clearly understand the initiative and thus have realistic expectations. This reservation can be overcome by having standardised and formalised procedures including explicit expectations and agreements for commitments. An appointed project coordinator could help mediate between the parties.

**Prior situation assessment:** One country officer mentioned that close attention should be paid to work that has already been done to avoid duplication of efforts.

#### *Structure*

##### Reinforcing inputs

Stakeholders validated the organisational structure envisioned by internal actors and the idea to start the work with selected pilot projects. For this, it was suggested to identify countries with demonstrated interest in obtaining support and where UNDP presence is strong. Another approach to help project implementation is to cooperate with initiatives related to UN conventions, which

have a more enforceable presence and capacity to move forward.

The issue of funding was also key for interviewed centres. Beyond initial funding, maintaining it to keep an initiative running has proven to be difficult, not least because donors' focus may change. Moreover, the goals of the clearinghouse might not reflect those of the donors, and this can hinder its ability to support requests.

#### Novel inputs

**UNDP local staff:** UNDP Country Officers argued that their departments are often understaffed and need support to take on the extra responsibilities associated with the clearinghouse.

**Clearinghouse staff:** The need to reflect upon which talent to be hired or sourced was highlighted. Adding a project coordinator to ensure projects and actors are conforming to a certain standard and delivering up to expectations was suggested. The role of a requests coordinator, tasked with identifying, receiving and channelling requests could also be included.

Standardised and formalised procedures for:

- Project prioritisation, guided by (1) strategy documents, (2) the feasibility of obtaining funding, and (3) proof of local political commitment and high level support
- Commitment from supporters and demand side actors. Previous experiences related to Avfall Sverige and UNDP pilots on zero waste strategy during 2021 have demonstrated that such commitment is pivotal to ensure the projects aim can be fulfilled
- Systematic internal and external communication to enable timely

feedback and that actors are not working in silos, which would hinder the robustness of solutions.

**Collaboration with Swedish municipalities:** It was mentioned that the rigidity that oftentimes characterises Swedish municipalities' budget plans should be considered. In this sense, permanent agreements might work better than ad hoc requests in order to ensure resources are available and that the quality of work is ensured.

### *Services*

#### Reinforcing inputs

The proposed broad range of service offerings were perceived as useful by the interviewees. Both demand and support sides saw the clearinghouse as a mediator between the UNDP and the actual local needs and actors. In addition, legal or judicial support and advice were mentioned as part of the service offering. The proposed training should target actors along the entire product lifecycle, from producers to consumers to waste management solution providers, the youth, local governments, among others. Likewise, many interviewees expressed the need for practical operational support through the clearinghouse; capacity building, including technical and institutional training; and assistance for new or existing waste associations.

#### Novel inputs

**Finance:** One Country Officer mentioned the benefit of enabling those small scale businesses that are already in the waste recovery industry to access loans and financing in the form of lower interest rates or longer payment periods in order to scale up and increase their recovery rate.

**Design for capacity building:** There is a need for capacity building for many local actors

in the Global South. However, it was suggested that capacity building designs and approaches need updating to make it more attractive, relevant and ultimately impactful. Thus, going beyond the usual workshops and training, highly involving multiple actors.

**Technology transfer:** A point of consideration that came from an academic is that it is important for the clearinghouse to first provide all other possible tools and systems that could be used before introducing sophisticated technologies.

**Results evaluation:** Real impact evaluation might be difficult. However, an actor from another centre mentioned that they evaluate their success by measuring the number of training sessions, participants, number of tools downloaded by people, number of educated cities, amount of investments mobilised, and others.

### *Communication Management*

#### Reinforcing inputs

Various interviewees validated the idea of using UNDP channels for interaction - as it is recognised that the UNDP has a strong local presence - and making use of multiple existing local channels for information dissemination.

#### Novel inputs

**Actionable ideas for communication:** Interviewees referenced a digital catalogue of projects and experts, which would bypass a connecting middleman. Media lists and social media were also mentioned as useful tools in most contexts, while consideration was given to other channels such as radio, posters, and more.

**Accessibility and usability of channels, regarding:**



**Avoiding “private” channels:** When relying on existing channels, it is important to ensure that in practice they don’t become “private”, i.e. only accessible to those with a level of previous involvement. For this, it might be useful being explicit about who should be able to reach the information and how to make the channels known.

**Importance of translation:** Multiple actors mentioned the issue of translating advice or expertise into local languages to make it more accessible.

**User-friendly digital platforms:** Any digital platform should be designed to facilitate demand side actors to find the information or support they need.

**Academic knowledge transfer:** Besides involving local academic institutions to develop context-relevant knowledge, earlier European academic output (i.e. from 10 years ago), may be relevant and transferable to some extent.

**Tailored content:** Identifying distinct target audiences and using them as a guide to generate contents and tailor channels has been mentioned as relevant by other centres.

### *Network and Partners*

#### Reinforcing inputs

Interviewees reinforced the idea of sourcing expertise from a wide range of actors. It was suggested to consider UNDP expertise as part of potential support as this is common practice within the organisation. For actors in the European context, practitioners, consultants and academics engaged in practical work may be relevant. Development banks were also a key actor mentioned by several interviewees.

#### Novel inputs

**Partners with local knowledge:** A recurrent theme was the need for experts to understand the local context. One vision was that advisors should ideally spend at least six months in-country to adequately understand the context. Others argued that experts should already be knowledgeable in this area, or at least should be willing to learn and adapt. Representatives from UNDP emphasised harnessing local knowledge and creating connections with and between practising professionals in the region.

**Potential stakeholders:** The local private sector (including waste management companies and producers), consumer interest groups, behavioural science researchers, NGOs with local presence, the informal sector, local municipal associations, other UN bodies and innovation organisations to pilot and accelerate ideas were all highlighted. Selected suggestions regarding how to involve these actors included:

- **Private sector:** Local waste management companies can be a part of the solution. Caution should be exercised against including them in early decision making due to potential conflicts of interest.
- **NGOs:** There are many local and international NGOs active in the Global South that have established a presence and can serve as mediators and champions in the projects.
- **Informal sector:** In countries without strong municipal management of waste, services are provided by the informal sector, making their inclusion essential.
- **UN bodies:** UNICEF, UNEP, the WHO, UNESCO, and UNOSSC could all be collaborators. Many already have a strong local presence and aligned interests.

**Potential biases in partners selection:** When sourcing local support, there is a risk that a limited number of actors who are closer to the clearinghouse's local networks are recurrently involved in projects, leaving other potential partners out of the picture, which should be taken into account to anticipate potential biases.

### *Local Context*

#### Reinforcing inputs

The need to understand and adapt to the local context is considered a key success factor. Lacking financial investments and regulatory frameworks have been mentioned by multiple external Stakeholders as barriers to further waste management efforts locally. Additionally, lacking awareness and data has been confirmed to be a challenge. The lack of such data leads to the challenge of identifying optimal pilot projects and potential investment opportunities.

#### Novel inputs

**Policy influence:** All the actors from the demand side acknowledge that the UNDP is able to contribute to policy development in these countries. Hence, they believe that the clearinghouse also has this potential.

**Regulatory dynamics:** Acknowledging that decision making processes for waste management varies from country to country, some external actors mentioned the importance of understanding the regulatory dynamics in a country in order to know at which level to intercede.

**Lack of physical infrastructure:** There is generally a lack of physical infrastructure in these countries and also a lack of technical expertise. Thus, these needs have to be considered in each context before giving advice for waste solutions.

**Institutional inefficiency:** A large number of interviewees also stated that there are institutional inefficiencies in these countries (e.g. bureaucracy, corruption, political self-interest). As such, these inefficiencies need to be accounted for before introducing new structures, be they for governance or business models.

**Assessment of requests:** One academic argued that the clearinghouse should consider assessing the requests that they receive and that sometimes these requests might not always reflect actual needs. For instance, corruption and bribery can play a role in determining which projects get brought forward by authorities. Furthermore, requests may be influenced and tailored to conform with criteria of global development organisations to secure funds rather than to best support actual local needs.

**Central governments:** The prevalence of centralised governments in developing countries, where budgets and decisions are highly controlled by the national government, may hinder the ability of municipalities to participate in initiatives if higher level support is not present. This requires considering strategies to involve central governments in the network, which is supported by UNDP offices experience, which usually create strong links with this level of government.

## **Workshop Inputs**

The following section summarises the primary takeaways obtained from the workshop discussion, organised around three topic questions proposed to the workshop participants:

### *Centralised Governments*

It was discussed that the clearinghouse could reach municipalities in centralised governments through:

- a. Channelling the efforts of the clearinghouse through UNDP Country Officers since their projects have outreach to municipalities and networks of contacts at this level.
- b. Municipal/regional associations in these countries. Where there is no such association, the clearinghouse helping to create one will be valuable.
- c. Having pilot projects in selected cities to provide an example for the rest of the country, and as such, making it easy for the clearinghouse to engage other municipalities directly.
- d. Gearing tools of the clearinghouse towards municipalities. This will make it much easier to reach the target audience (for instance, by proposing financial instruments or supporting planning tools applicable at the municipal level).

### *Approachability of Initiative*

Youth movements are strong in many countries and have an informal influence that can be harnessed by the UNDP to make waste management topics more approachable. Likewise, multiple workshop participants mentioned that school systems can also be useful avenues for waste education, as has been done in Sweden for years.

Accelerator labs have a unique approach to these issues and thus partnerships with these organisations can innovate toward progressing the SDGs in these countries.

It is furthermore crucial to connect the issue of waste generation with other

environmental topics (e.g., pollution, biodiversity) to garner support as for many in the public it is viewed as an isolated issue.

### *Platform Services*

The most valuable aspects of the platform, which were discussed during the workshop are: a) user-friendliness, b) showcasing pilot projects to facilitate collaboration across multiple levels of governments, c) access to e-learning d) contact with waste management experts and other network actors (e.g., development banks, UN initiatives) and e) lessons learned from other municipal efforts.

### *Additional Insights*

Actors brought up some spontaneous points beyond the structured discussion: a) the initiative should be understood as a dynamic effort, that can evolve and be shaped as it gathers more experience, b) expectations from external actors may be bigger than what has been envisioned, c) other centres are valuable sources of information to understand how a clearinghouse should be organised, and how to provide advice and training in practical terms, and d) a pending question is to ascertain whether there is willingness to pay from those requesting support to obtain services facilitated by the clearinghouse.

### **Other Initiatives Review**

This section provides a summary of research regarding other initiatives that are considered to be informative for the clearinghouse, including information about those initiatives whose representatives were interviewed.

Centre	Internal actors	Goals, roles ad services	Networks	Highlighted aspects
CCET <i>interviewed</i>	Joint partnership between IGES and IETC (UNEP)	Assisting national, regional and local governments in Asia Pacific to develop waste management systems through:  -Policy and institutional building -Capacity building and implementation -Disseminating impact and networking	Partnerships are developed depending on project or event	Potential partner  Further learn about: Project and network examples, project selection and preparation procedure
Waste Wise Cities Initiative	UN Habitat	Invites cities globally to join by incorporating a list of principles in solid waste management strategies  Support with: Waste Data & Monitoring, Knowledge & Good Practices Sharing, Advocacy & Education, Project Finance & Bankability Support, Resources	Member cities: supporters and change-makers  Waste wise network: affiliates and Waste Wise Partnership	Potential partner  Further learn about: Network structure, toolkits. Showcase of good practices, Concrete activities, demand-side oriented website  Regional chapter: Africa Clean Cities Platform

Table 1. Centres focused in waste management

Table 1 showcase key points from two of the four initiatives that were prioritised for a deeper analysis. In addition to providing basic information about each, a column for “highlighted aspects” was added to quickly direct the clients to elements that may be particularly useful for them. To allow clients to make better use of the information, they were provided with more detailed tables with a summary of the four selected initiatives, which include links to access information- with special attention to the “highlighted aspects”- and further justifications about the inclusion of each initiative. Additionally, an overview of a more extensive group of initiatives working around waste management was provided to the clients, to facilitate further efforts identifying key actors and how the clearinghouse fits within this context.

Overall, the information is intended to guide clients towards potential partnerships, refine their roles and goals in light of their surrounding ecosystem, and learn from others how to better develop and operationalise their vision.

## Recommendations

Our recommendations are based on our gained understanding obtained through the interviews with stakeholders, the workshop, and desk research.

## Roles and Goals

We suggest adhering to the intended roles and goals as they were supported broadly. For simplicity, we suggest grouping the six services into three overarching themes: Alliance Building, Education, Advisory Services (for policy, financing and technology).

The clearinghouse is perceived as a mediator between requesters and supporters. We recommend this to be guided by strategy documents, and through a systematic assessment of requests, through which local motivation levels and political support can be evaluated. We recommend to clearly and explicitly align expectations through written agreements of commitment by the parties involved, as this will assist the project coordinators in mediating the quality of deliverables. Furthermore, we advise conducting local situation assessments in order to avoid duplication of efforts.

## Services

We strongly recommend employing a holistic and inclusive approach to awareness creation and education, targeted at the entire waste cycle and including diverse stakeholders from youth, the local



government, the private sector and other population groups.

Financing schemes should be made available for small-scale businesses that are already in the waste recovery business to assist in scaling up their recovery rate. Large investments which include technological transfer should be assessed cautiously.

### *Structure*

We suggest operationalising the clearing-house, as proposed, through a subdivision within Avfall Sverige, creating a flexible organisation governed by a steering committee.

Since the initiative would be launched through selected pilot projects, we suggest identifying countries, regions or municipalities which had demonstrated a high interest in obtaining support. Furthermore, the clearinghouse should prioritise those areas where UNDP local presence or where alliance potential with initiatives related to UN conventions is strong to ensure successful pilot projects. Nevertheless, to ensure awareness and usage of the initiative we strongly encourage informing other country officers and local actors.

Assessing the performance of the clearing-house and the relevancy of its goals, roles and services is crucial to improve them and enable further funding. Considering that measuring impacts is difficult due to long timeframes and geographical distance, an option could be to evaluate more immediate results and outcomes based on an initial project proposal rather than trying to evaluate the impact. Furthermore, immediate results and outputs can be assessed through KPIs, considering aspects such as number of training sessions provided, number of downloads of a tool, number of educated cities, or the amount of

investments mobilised for small scale businesses. Lastly, the anticipation of future funding needs should be made explicit in its planning and strategies to dedicate resources to identify and secure funding opportunities.

### *Communication Management*

We recommend implementing a digital platform which is designed to facilitate the demand side stakeholders to find the information or support they need. This one-stop-shop could showcase information per area of support, such as education or financial advice, and/or per topic, such as food waste, plastics, or region. Services included on such a platform could consider access to e-learning, contact with waste management experts and other network actors (e.g., development banks, UN initiatives), or lessons learned from other municipal efforts.

To complement the digital platform, media lists, social media and physical channels can be considered, always considering the local context. Furthermore, we strongly recommend tailoring content to a previously identified target audience which needs to include the translation into local languages to make it more accessible.

We support utilising the existing channels which have been established by the UNDP country officers. However, we propose to be mindful since such channels, willingly or not, may remain exclusive to those who have some previous knowledge or involvement with the utilised channels.

### *Network and Partners*

We recommend mapping and categorising the current initiatives tackling waste management. This will enable identifying local networks and avoiding the duplication of

efforts (as well as potential financial restrictions in case a similar initiative is already being supported locally).

From the supportive side, we recommend sourcing expertise from a wide range of actors including municipal members of Avfall Sverige, other actors within the UN, international cooperation organisations, associations, academia, practitioners, consultants and development banks. In order to ensure consistent resource availability and quality adherence, permanent collaboration agreements with specific Swedish municipalities might work better than ad hoc requests. Additionally, establishing a clear point of contact for each member municipality and formalising communication channels are considered important. We would like to emphasise the recurrent expression for the need to always include local experts, or experts that understand the local needs and context.

### *Local Context*

We recommend developing strategies which consider the involvement of central governments in the network, since countries in the Global South are often characterised by centralised decision-making bodies. Hence, we suggest collaborating with the UNDP offices, as they usually create strong links with this level of government.

Understanding the local context, needs and existing initiatives will be of utmost importance to further the goal of zero waste. Connecting the issue of waste generation with other topics such as pollution, human health, or biodiversity loss will not only help tackling the issue from different perspectives but can also help in multiplying

benefits, pool resources and hence achieve systemic improvements.

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### **List of people interviewed**

- IIIEE, Postdoctoral fellow, 18 October 2022
- IIIEE, Senior lecturer, 21 October 2022
- Swedish Municipality, Project leader, 17 October 2022
- UN OzonAction, Information Manager, 21 October 2022
- Avfall Sverige, CEO, 7 October 2022
- Avfall Sverige, Senior advisor, 7 October 2022
- CCET, Director & Programme Manager, 27 October 2022
- UNEP, Senior Advisor, 28 October 2022
- UNDP, Programme Analyst, 10 October 2022
- UNDP, Regional Officer, 17 October 2022
- UNDP, Regional Officer, 19 October, 2022
- UNDP, Regional Officer, 17 October 2022
- UNDP, Country Officers in Latin America, 24 October 2022
- UNDP, Country Officers in Africa, 24 October 2022
- UNDP, Country Officer in Asia, 25 October 2022



## REFLECTIONS

Batch 28 has shown their ability to understand and analyse real-life challenges and deliver tangible solutions to the questions posed by clients from various industries and regions. The different projects reflect that in-depth understanding of the challenge is required to improve resource efficiency solutions.

We from Team Helsinki were glad to contribute to improving the Finnish citizens' understanding of their consumption habits. Finland is a resource intensive country. SITRA's goal to reduce the impacts of national consumption will also ameliorate the wellbeing of Finnish citizens.

We from Team Portugal want to point out that a main takeaway of the project has been lessons on interview technique. Adapting to a specific interviewee while also getting consistent data is difficult. Furthermore, we have learned that effective teamwork requires communication, commitment and compromise.

We from Team Oslo recognise that the success of a green startup relies just as much on *creating an environment* conducive to sustainable practices as it does traditional competitiveness. Policy, and the culture which advances it, are both necessary to counteract the operational burdens carried by the large majority of sustainable business models.

We from Team Japan have learned from that decarbonisation cities requires a comprehensive approach, both in terms of stakeholders involved and implemented measures. Despite the transferability challenges posed by benchmarking in different local contexts, working with the municipality of Utsunomiya has shown that cross-cultural collaboration is not only possible but also extremely rich in learnings.

We from Team Perth acknowledge the systemic challenge of decarbonising mobility and the complexities that electrification entails. In particular, our team found value in engaging with vastly different stakeholders and being exposed to a myriad of perspectives that are necessary for transformative changes.

We from Team Volvo Energy hope our project has shown that market opportunities related to sustainable ventures may come with high uncertainty and complexity. Working on the future of electrification is particularly exciting as the scale of potential impacts is enormous.

We from Team Sharks recognised the importance of involving all stakeholders to drive systems change. Understanding and improving a major global system - such as the circularity of steel - cannot be limited to a single question. The underlying reasoning and problem identification must simultaneously be questioned.

We from Team UNDP-Avfall Sverige recognise the importance of incorporating the diverse views and needs of various stakeholder groups connected to the global waste challenge. The project highlighted that global collaboration and knowledge sharing is most beneficial when the local context considered.





## THE IIIEE

The International Institute for Industrial Environmental Economics, or in short IIIEE, is an international and interdisciplinary centre at Lund University. Established by the Swedish Parliament in 1994, the IIIEE has a mandate to advance sustainable solutions to catalyse climate neutrality and resource-efficient economies. The Institute is committed to producing rigorous, impactful and solution-oriented interdisciplinary research, focused on the following four areas: Business Management and Practice, Consumption Governance, Urban Transformation, and Policy Interventions. All education at the IIIEE is designed to equip students with the skills, knowledge and networks to drive sustainability transitions. The following topics are taught and researched at the IIIEE through two master's programmes, as well as PhDs: environmental law, extended producer responsibility, environmental management systems, life cycle assessment, corporate environmental management and environmental policy evaluation. To this date, more than 1000 environmental professionals from more than 115 countries make up the IIIEE's Alumni Network. The graduates hold positions in consulting, government, industry, international organisations and academia. The IIIEE brings together cultures from all parts of the world and recruits students from various disciplinary backgrounds. The authors of this report, students from Batch 28 of the Environmental Management and Policy (EMP) master's programme, come from 23 countries. Their backgrounds include anthropology, law, business management, philosophy, geography, economics, biology, chemistry, political science and sociology.





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