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Sustainable Business & Innovation

**Evaluating the Transformative Outcomes and (Transformative) Social Impacts of The
Ocean Cleanup's River Projects**



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Abstract

Plastic pollution greatly threatens all ecosystems, especially marine and freshwater environments. The Ocean Cleanup is an ambitious nonprofit organization focused on removing legacy plastic from oceans and, more recently, rivers. Such missions demand transformative change. To evaluate the transformative success of The Ocean Cleanup's river deployments, this study utilizes transformative outcomes, a concept within the Transformation Innovation Policy (TIP) framework. The goals of this study are to identify the presence of transformative outcomes in the river deployments and derive recommendations based on these outcomes. An additional aspect of this study is to provide advice for how The Ocean Cleanup can also leverage the (transformative) social impacts of its river deployments. Overall, this research aims to promote The Ocean Cleanup's progress towards its mission. Using a deductive, qualitative, and formative approach, this research assesses the transformative outcomes and social impacts across four of The Ocean Cleanup's river deployments - the United States, Malaysia, Jamaica, and the Dominican Republic. The results reveal the importance of nurturing and building niches, expanding and mainstreaming niches, and expanding and unlocking regimes in achieving transformative success, although the latter process is less observed. Beyond this, the study highlights the influence of socio-technical contexts (place), types and number of solutions deployed (level), and timelines (time) on the transformation process itself. Additionally, this study provides insight into the role of The Ocean Cleanup as a non-state actor, showcasing its influence beyond local-level impacts. Lastly, community-focused activities and focus on cultural social change are key considerations for The Ocean Cleanup as it enhances its social scope.

Keywords: The Ocean Cleanup; plastic pollution; transformative outcomes; Transformation Innovation Policy; social impacts; non-state actors.

Executive Summary

This thesis provides many valuable insights for The Ocean Cleanup, most of which are summarized in the following Table.

Table: Recommendations for The Ocean Cleanup. See Section 5 for more justification.

Number	Section	Recommendations
1	5.1.1	It is important that <i>shielding, learning, networking</i> and <i>navigating expectations</i> are enabled broadly and deeply through activities of The Ocean Cleanup and its partners.
2	5.1.1	To create shared visions and help guide niche development, activities are needed that enable the <i>navigating expectations</i> outcome from the onset of the river deployment.
3	5.1.2	To extend the niche, it is necessary for The Ocean Cleanup to continue <i>circulating</i> knowledge at the global level.
4	5.1.2	It is important to assess the individual needs of the river deployment's niche when deciding what 'expanding and mainstreaming niches' transformative outcomes to employ, how they should be targeted, and when. <ul style="list-style-type: none"> a) For example: In areas where the socio-technical system is more uncertain, complex, and disorganized, there is a stronger need to institutionalize the river deployment quickly.
5	5.1.3	More attention is needed on enabling transformative outcomes that 'open up and unlock the regime'.
6	5.1.3	It is not necessary for The Ocean Cleanup to dedicate specific resources towards activities that support <i>unlearning and deep learning</i> and <i>changing perceptions of landscape pressures</i> .
7	5.1.3	Specific attention is needed to facilitate de-aligning and de-stabilizing outcomes.
8	5.2.1	It is important to consider the institutional context of deployment locations in determining the breadth of transformative activities required to achieve a successful transformation. <ul style="list-style-type: none"> a) A broader set of transformative activities are needed in deployment locations where the institutional environment is less established or poorly managed. For instance, in deployment locations with lower waste management archetype classifications. b) A narrower set of transformative activities are needed in deployment locations where the institutional environment is more established or better managed. For instance in deployment locations with higher waste management archetypes.
9	5.2.1	It is important to select local partners that address the breadth of the riverine plastic problem in the given deployment location.
10	5.2.2	Developing programmes, or deploying multiple solutions, is important for The Ocean Cleanup to expand and mainstream niches.
11	5.2.2	The Ocean Cleanup should focus efforts on policy-mix EPEs, for the deepest transformations (across technology, actors and institutions).
12	5.2.3	Acceleration activities can be used by The Ocean Cleanup (and its partners) to speed up broad and deep transformations.
13	5.3	Diverse actor networks are essential for The Ocean Cleanup as it enacts socio-technical transformations as a non-state actor.
14	5.4	Community-centered activities enacted by The Ocean Cleanup's partners are essential in leveraging social impacts.
15	5.4	Cultural change is the most challenging social impact to modify, yet it is also the most observed in the river deployments. Activities that enable this impact, should be amplified for The Ocean Cleanup and its partners.

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1.0 Introduction

Plastic products, although convenient, cause pollution, presenting a planetary threat if left untreated (Borrelle et al., 2020; Vince & Hardesty, 2017). Plastic pollution is especially relevant in marine and freshwater ecosystems, as plastic from the land is often swept into water bodies during precipitation events. This causes detrimental impacts to aquarian ecosystems and local regions (Borrelle et al., 2020).

Recent research and media attention on the harms of plastic pollution has prompted solution-centered initiatives (Vince & Hardesty, 2017). Such initiatives take place on the macro-level (e.g., EU set missions like the Plastics Treaty), national level (e.g., legislation, policies, and action plans), community or civil level (e.g., education and outreach campaigns) (United Nations., n.d.; Vince & Hardesty, 2017). Then, there are entrepreneurial engagement initiatives (Vince & Hardesty, 2017), like ones set by The Ocean Cleanup which aim to tackle 90% of ocean plastic pollution by 2040 using technological solutions (The Ocean Cleanup, 2023a).

Since its inception in 2013, The Ocean Cleanup has evolved its approach to ridding the oceans of plastic. In 2019 the organization presented its program with focus on river pollution that had been in the works since 2015, setting an ambitious mission of ‘preventing 80% of floating plastic being emitted through the 1000 most polluting rivers by 2040, by deploying Interceptor solutions’. To aid in expanding into tackling plastic pollution in rivers, The Ocean Cleanup launched the River Department. To date The Ocean Cleanup has deployed eleven Interceptors in seven countries (The Ocean Cleanup, 2023b). The River Department and its solutions are currently in its first validation phase. This phase encompasses the first twenty rivers where a solution is deployed, ensuring its efficacy, approaches, and credibility. Once this is achieved, the organization plans to continue to scale gradually - with distinct steps that continue to validate and expand the program. Each river solution can be conceptualized as smaller steps that accumulate and lead to the larger river mission, consequently, contributing to the primary goal of ridding the oceans of plastic.

The ultimate goal of The Ocean Cleanup is to dissolve itself once the mission of ridding the oceans of plastic is achieved. To accomplish this end goal, the socio-technical systems that contribute to the plastic pollution problem must undergo transformative change. Transformative change is multidimensional - extending beyond technologies and encompassing changes to actors and institutions (Andersen et al., 2023; F. W. Geels, 2002). The Ocean Cleanup has directly begun to tackle this change. First, by using technological innovation to address ocean plastic pollution. Second, by extending its approach to rivers,

tackling ways to prevent plastics from ending up in the ocean in the first place. The extent to which The Ocean Cleanup is achieving transformative change through its activities remains a key organizational question, one that heavily influences its ability to scale and achieve its mission (Molas-Gallart et al., 2021). This question is answered through evaluation; however, it is challenging to study (Janssen et al., 2022).

Concepts in Transformation Innovation Policy (TIP) help conceptualize river deployments, its transformational success, and provide a basis for evaluation. To evaluate the transformational success of The Ocean Cleanup's River Department, its river mission is conceptualized as a TIP. The goal of the TIP is to eliminate riverine plastic emissions into the ocean; transforming rivers from those that emit plastic, to ones that do not.

A TIP perspective aids in directing change agents towards more transformative impacts (Ghosh et al., 2021) by analyzing the changes initiated by socio-technical transitions (Molas-Gallart et al., 2021). Conceptual understandings of TIP and how it is designed, implemented, and assessed are still quite exploratory (Molas-Gallart et al., 2021).

Elaborating more on TIP evaluation, most existing sustainability transitions frameworks, like Quantitative Systems Modelling and Socio-technical Transition Analysis (Turnheim et al., 2015), focus on the macro- or meso-level of socio-technical change and provide little direction in how to assess the input of more localized efforts (Molas-Gallart et al., 2021). The Ocean Cleanup's river deployments are localized efforts, therefore, evaluation at this level is necessary. Experimentation provides a solution to this and is thought to play a key role in TIP evaluation (Schot et al., 2019; Schot & Steinmueller, 2018).

Expanding on the concept of experimentation, Experimental Policy Engagements (EPEs) are individual projects, programmes, and policies that are a part of a broader, existing transformation process (Schot et al., 2019). EPEs may start as small scale experiments (projects) that contribute to socio-technical change, like one Interceptor solution deployed in one river. However, its transformational contribution is enhanced when experiments combine into a programme. For The Ocean Cleanup, a programme is when numerous Interceptors are added to the same river or region, strengthening its local impact. Transformation is further promoted when technological innovation projects and programmes are combined with other projects or organizations that tackle other dimensions of socio-technical systems (Molas-Gallart et al., 2021).

EPEs, however, cannot be used to assess transformational success as, alone, they do not result in transformative innovation (Schot et al., 2019). More broadly, transformative change often encounters problems related to the absence of directionality, misdirection of demand

expression, insufficient policy coordination and lack of reflexivity (Ghosh et al., 2021). To address challenges in orienting change efforts (Ghosh et al., 2021) and the shortcomings of EPEs alone (Schot et al., 2019), transformative outcomes (TOs) are useful.

Transformative outcomes are processes or solutions that result in deeper transformations, leading to changes in the rules that influence actors (individuals, groups, organizations) behavior (Ghosh et al., 2021). TOs is an emerging field of study. Existing studies (Ghosh et al., 2021; Molas-Gallart et al., 2021; Schot et al., 2019) have highlighted twelve TOs across three macro-processes: (1) building and nurturing niches; (2) expanding and mainstreaming niches; and (3) unlocking and opening up of regimes. These TOs represent the basis of socio-technical change (Schot et al., 2019). EPEs accomplish TOs via continuous observation, evaluation, trial, and reflexivity (Ghosh et al., 2021; Schot et al., 2019). Thus, TOs are a reflexive action framework and not a prescriptive method that leads to transformation (Ghosh et al., 2021).

When introducing the TO framework, Ghosh et al (2021) highlight the need to test TOs in different contexts to understand what outcomes apply. Additionally, knowledge on how to increase the quality of outcomes and how to extend ongoing actions to accomplish more TOs is necessary (Ghosh et al., 2021). The need for more research is further highlighted by the lack of literature in this space. There are only three papers to date that discuss TOs in the context of EPEs (Ghosh et al., 2021; Molas-Gallart et al., 2021; Schot et al., 2019). Aiming to address this research gap, this study has formulated the following research question (RQ):

***RQ 1:** What transformative outcomes are present in The Ocean Cleanup's river deployments?*

***RQ 2:** What can The Ocean Cleanup do to enhance the transformative outcomes of its river deployments to achieve more progress in completing its mission?*

To address these research questions, it is essential to evaluate what TOs are present or absent in river EPEs. This then illuminates ways to leverage and enhance TOs for success in ongoing and future deployments, materializing as recommendations for The Ocean Cleanup. Further, answering these research questions contributes to the theory on Experimental Policy Engagements and transformative outcomes, due to the interesting characteristics of The Ocean Cleanup as a mission initiator. First, The Ocean Cleanup is a nonprofit and not affiliated with a government. This also presents a scientific contribution in the mission theory space, as there is nascent literature on evaluation of nonprofit-set missions (Janssen et al., 2021). Current

debate focuses on state-led missions (Janssen et al., 2021; Klerkx & Begemann, 2020; Mazzucato, 2018); however, The Ocean Cleanup takes a prominent role in coordinating a mission that is like the EU mission on clean oceans and waters (European Commission, n.d.). Therefore, this research increases understanding of non-state actors pursuing a societal mission. Using TOs as a basis presents a new methodology for this. Additionally, The Ocean Cleanup possesses a portfolio of EPEs at different levels, stages, and socio-technical landscapes, but with the same mission. Applying TOs to EPEs that vary so much across contexts answers Ghosh et al. (2021)'s call to address place-specificity of transformation processes.

The Ocean Cleanup's TIP or river mission is an important, yet ambitious one. For it to be accomplished the River Department must optimize and scale its efforts. Understanding the positive and negative impacts of its river deployments is key information in achieving such scaling as it can be used to strengthen the success of existing EPEs, aid in project acceptance (via communicating social benefits) and help scope future projects based on this knowledge. Studying The Ocean Cleanup's river mission also addresses the absence of literature on understanding the actual impact of transformative missions or TIPs (Janssen et al., 2022). Currently, The Ocean Cleanup only measures its impact on the amount of plastic extracted by Interceptors; however, this process has other (social) impacts. To illustrate a few anecdotally, the River Department and its local partners create local jobs, invest in communities, and create additional revenue streams. These examples are not necessarily transformative in nature. Impact within the context of TIP, implies that the socio-technical system has been transformed - meaning the impact is transformative (Molas-Gallart et al., 2021). It is therefore necessary to make a distinction between social impacts and transformative social impacts. Both are relevant to The Ocean Cleanup; however, the latter is more related to RQ 1 and 2, and therefore, more interesting to this study. This prompts an additional research question:

RQ 3: What can The Ocean Cleanup do to enhance the (transformative) social impact of its river experiments to achieve more progress in completing its mission?

Before The Ocean Cleanup can enhance its social impacts, it must evaluate what it is currently achieving. This study does not aim to quantitatively measure social impact, but rather to identify them and the mechanisms which led to various types of social impact. Scoping social impacts in this way aligns with realist evaluations, a concept related to TIP evaluation, which is used to scope how causal mechanisms help experiments function, allowing for more complete understanding of social and behavioral mechanisms that underlie the experiment

(Haddad & Bergek, 2023; Rolfe, 2019). Examining social impacts over different contexts helps to achieve this and aids in providing recommendations for how the impacts themselves can be leveraged. The different contexts studied here are the influence of location, the level of EPE (project, programme and policy-mix), and time duration.

All three research questions are addressed by evaluating The Ocean Cleanup's river mission or TIP. The evaluation employs a deductive, qualitative, and formative approach. Deductively, this study applies transition theories (Experimental Policy Engagements and transformative outcomes) using the unique, single case of The Ocean Cleanup from which four embedded subcases (EPEs of different locations, levels, and speeds) provide a better understanding of variation and highlight the pitfalls of the existing theory (Elzinga et al., 2023; Dubois & Gadde, 2002). Qualitative and formative methods such as Theory of Change and outcome harvesting operationalize concepts from the transitions literature and aid in answering the research questions.

2.0 Theory

2.1 Transformative Innovation Policy

Transformations, like the one The Ocean Cleanup is trying to achieve through its river deployments, demand change in all dimensions of the socio-technical system. Technology, actors, and institutions all need to undergo change (Andersen et al., 2023; F. W. Geels, 2002). This study utilizes concepts from Transformative Innovation Policy (TIP). TIP arose as a solution to the disconnect between traditional innovation policy and pathways for sustainable socio-technical change (Schot & Steinmueller, 2018; Boon & Edler, 2018; Ghosh et al., 2021). TIPs must overcome the four common challenges of transformative change – the absence of directionality, miscommunication of demand, absence of policy alignment, and reflexivity failure (Weber & Rohracher, 2012).

Experimentation that builds upon concepts from Multi-Level Perspective (MLP) like niche, regime, and socio-technical landscape is theorized to play a role in surmounting such challenges (Ghosh et al., 2021; Schot & Steinmueller, 2018; Geels et al., 2016). Niches are spaces in which new socio-technical systems (i.e., clean rivers) are safe to develop (F. W. Geels, 2002; Smith & Raven, 2012). They often do so in a quick manner (Geels, 2002). Niche actors occupy or work in a targeted market area rather than contending in broader, mainstream markets (Geels, 2002). They possess characteristics that are different from the regime. These differences may employ different principles, utilize alternative technologies, or communicate

differently with stakeholders (Molas-Gallart et al., 2021). MLP provides a framework for understanding the interactions between niches, regimes, and landscapes (Ghosh et al., 2021; Geels, 2002).

In the context of this study, The Ocean Cleanup is a niche actor, operating in different niches. Regimes are far more constant, yet they are always exposed to the socio-technical landscape, which consists of external and persistent economic, social, cultural, or environmental trends. Regimes, through their dominant structures, enable or restrict the transformative actions of niches. Therefore, transitions most likely occur when the regime is destabilized due to the pressures of the socio-technical landscape (Molas-Gallart et al., 2021). For The Ocean Cleanup, regimes are systems that contribute to riverine plastic pollution, governments or polluting incumbent firms, for example. If niches are sufficiently mature, they can influence or replace the regime (Molas-Gallart et al., 2021).

2.2 Experimental Policy Engagement (EPEs)

Through TIP, comes the concept of Experimental Policy Engagements (EPEs). EPEs encompass all the ways policy makers or mission initiators interact with experiments that initiate, support, or mobilize socio-technical transformation (Ghosh et al., 2021). The idea of experimentation for transformative change involves both a design attitude and an evolutionary attitude, encompassing the creative framing of problems and solutions and fostering a prosperous environment for societal experimentation, respectively (Schot et al., 2019; Schot & Steinmueller, 2018). This builds upon strategic niche management, where experimentation is a tool to build and grow niches and dismantle incumbency. With this understanding, experiments and niches co-evolve, setting the environment for transformation (Schot et al., 2019). EPE theory moves beyond transition theory's perspective of experimentation focused on building niches, emphasizing the role of experimentation in expanding niches and destabilizing regimes (Ghosh et al., 2021; Torrens et al., 2018).

Further, EPEs are not separate entities. They are steps in a multi-scalar transformation process (Ghosh et al., 2021). Similarly, The Ocean Cleanup does not conceptualize its river deployments as individual pilots, but as steps that will compound towards the ultimate goal of tackling plastic in the 1000 most polluting rivers. Molas-Gallart et al. (2021) distinguish three levels of EPEs – projects, programmes, and policy mixes – which aid in evaluating the multi-level nature of TIPs. Projects are experiments that consider social and environmental challenges and spur transformation (Molas-Gallart et al., 2021). In this study, this encompasses the individual deployment initiatives in each river. Programmes make connections between

several projects to increase success and create a more impactful transformational scope (Molas-Gallart et al., 2021). For The Ocean Cleanup, an example of this is multiple Interceptor solutions deployed in the same river or region. Policy mixes are when an alliance between river projects/programmes and other sectoral policies that address different elements of the socio-technical system forms (Molas-Gallart et al., 2021). Within the context of The Ocean Cleanup, this could include partnerships with organizations that tackle more systemic causes of riverine plastics (e.g., relationship with UNDP), for example. Molas-Gallart et al. (2021) posit that policy-mix EPEs generate the most socio-technical change, whereas project-level EPEs generate the least. Single EPEs (or even a portfolio of EPEs) do not result in transformation but rather in transformative outcomes (Schot et al., 2019).

2.3 Transformative Outcomes

Transformative outcomes aid in facilitating transitions and tackling societal challenges. They do so by focusing on understanding the current transformation dynamics, rather than deliberating on the transformational failures (Ghosh et al., 2021). The twelve transformative outcomes (TOs) lead TIPs or socio-technical missions towards more transformative aims. The TOs fall under three macro-processes: (1) building and nurturing niches; (2) expanding and mainstreaming niches; and (3) unlocking and opening up of regimes. These macro-processes come from Multi-Level Perspective (Molas-Gallart et al., 2021; Geels, 2002). MLP uses these macroprocesses to explain how socio-technical change requires reflexive and complex interactions between niches, regimes, and landscapes (Ghosh et al., 2021; Geels, 2002). Figure 1 provides a visual representation of the TOs through a MLP lens. The interplay of these three processes is essential for a successful transformation and does not necessarily occur sequentially or separately (Schot et al., 2019). To illustrate, destabilizing existing regimes ('opening up and unlocking regimes') could start the transformation process (Schot et al., 2019).

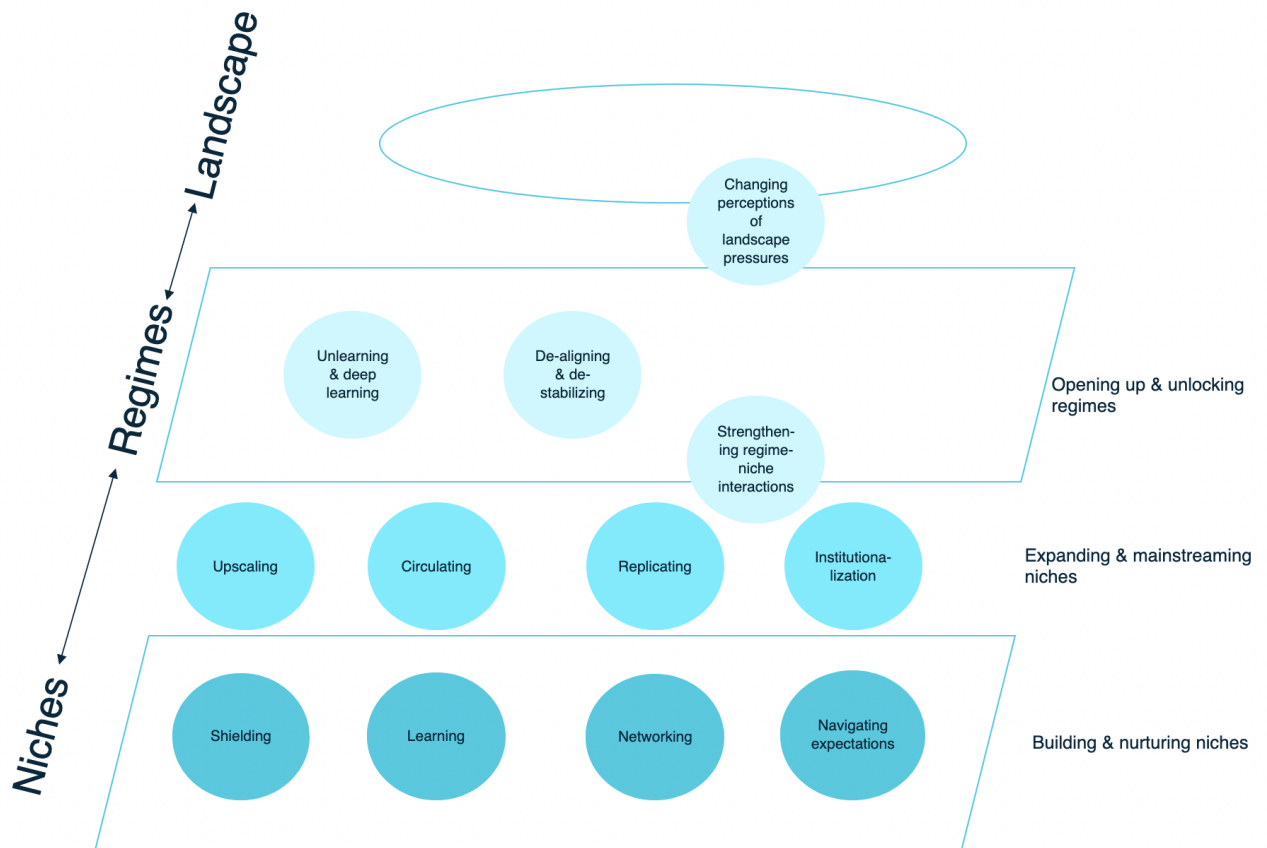


Figure 1: A visual representation of the twelve transformative outcomes and their analytical socio-technical level. Arrows between the niche, regime and landscape represent the dynamic and complex nature of the interactions between these socio-technical levels.

The following subsections present the twelve TOs as described by Schot et al (2019) and elaborated upon by Ghosh et al. (2021). Initial connections to The Ocean Cleanup’s river projects are made to aid in contextualizing this research and do not necessarily reflect the results of this study.

2.3.1 Building and nurturing Niches

Transformations need spaces where alternative practices that foster new rules and systems can develop, this space is called a niche (Geels, 2002). The following outcomes are presented as both broad and deep. Broad refers to increasing size of scope of the EPE (i.e., river deployment), while deep outcomes focus on enhancing the caliber and directionality of the process (Ghosh et al., 2021; Schot & Steinmueller, 2018). In this context, broad and deep outcomes implies that these outcomes are not only developed in the EPE, but also stretched and strengthened. Overall, this improves the quality of the transformative outcomes (Ghosh et al., 2021).

2.3.1.1 Shielding

Shielding provides protection for niche experiments both passively and actively. It ensures the optimal conditions for transformation are present, moving away from incumbent ideals (Ghosh et al., 2021). Protective measures can be geographic, institutional, and cultural (Molas-Gallart et al., 2021). However, shielding measures are not transformative on their own, but rather alternative solutions are not possible without their presence (Schot et al., 2019). Passive shielding encompasses the pre-existing supportive conditions already in a place (Schot et al., 2019). An example of this relevant to The Ocean Cleanup, is local investors or support groups (nonprofits) who provide financial or public support for specific river projects. Active shielding is concerned with deliberate interventions to create an optimal environment (Schot et al., 2019). For The Ocean Cleanup, this can include investment in existing waste management infrastructure in the niche to ensure plastics do not return to the river after extraction. Plastics returning to the river represent an exogenous threat that should be shielded against to protect the niche (Ghosh et al., 2021). The distinction between passive and active shielding is flexible and depends on the time of observation (Schot et al., 2019). Broadening is when passive and active shielding occur at the same time. Media campaigns which aim to promote or influence perceptions of an Interceptor solution are examples of broad shielding activities (Ghosh et al., 2021; Molas-Gallart et al., 2021). Deepening is when an active measure becomes passive (Schot et al., 2019). In other words, when shielding measures across system dimensions and contexts are aligned (Ghosh et al., 2021). This could involve making temporary permit exemptions permanent, for example.

2.3.1.2 Learning

Learning can activate first- and second- order learning and be broad and deep (Ghosh et al., 2021; Schot et al., 2019). First-order learning focuses on how actors can improve (Ghosh et al., 2021). Whereas second-order learning debates how structures and activities are framed, constituting a change in cognitive beliefs and values (Ghosh et al., 2021; Schot et al., 2019). Such changes are synonymous with sustainable regime shifts (if exhibited by all actors), which is necessary when regarding a learning process as transformative (Schot et al., 2019). Learning is deepened when opportunities are created to question beliefs about preferred solutions, problem definitions, etc. (Ghosh et al., 2021). Broad means learning occurs in multiple dimensions, like a) technical, scientific, and design aspects; b) markets, user preferences; c) cultural and symbolic meanings; d) industry networks and strategy; e) regulations and government policy; f) societal and environmental impacts (Schot et al., 2019). Broadening also

means a diversity of stakeholders are involved (Ghosh et al., 2021). Since successful niches create a new regime, all learning dimensions should be present (a-e) (Schot et al., 2019). The directionality of change is dictated by the societal and environmental impacts. Actors need to be reflexive to understand and observe the directionality of the emerging niche, changing the transformation as needed (Schot et al., 2019). Within the context of The Ocean Cleanup, environmental impacts measure the amount of plastic extracted using Interceptor solutions. This study aims to measure social impact, thus also contributing to their understanding of their directionality of change. Along this line, Schot et al. (2019) point to the importance of using learnings to understand who wins and loses, and then focusing additional efforts on marginalized and vulnerable groups. There are many examples of functions related to learning (e.g., knowledge gathering, training, prototyping, etc.); however, it is essential that this learning is retained (Schot et al., 2019).

2.3.1.3 Networking

Networking sets out to build a community behind the new socio-technical niche, promote collaboration between stakeholders, and deliver essential resources (Ghosh et al., 2021; Schot et al., 2019). This outcome aims to be broad and deep. Broad in the sense that diverse niche and regime actors (industry, government, users, and civil society) are included in activities, with significant focus on the voices of niche actors. Second-order learning is more readily induced when such broad networks exist (Schot et al., 2019). Deep networks refer to the increased ability to leverage resources, coordinate and trust each other over a longer period (Ghosh et al., 2021; Schot et al., 2019). Here, underlying networks are important, meaning actors can promote a niche while also being ingrained in the regime (Schot et al., 2019). For The Ocean Cleanup, this could resemble having a local government advocating against riverine plastic pollution. It also means that the network is inclusive, allowing participation from all relevant groups (Schot et al., 2019).

2.3.1.4 Navigating Expectations

Navigating expectations ensures that niche building goals are shared, learning and exploration is fostered, and shielding and nurturing activities are legitimized (Schot et al., 2019). For this to happen, there needs to be space for actors to create shared expectations around socio-technical challenges and assess the credibility (between niche actors), quality (offering additional proof), and stability (no longer contested) of these expectations, eventually leading to niche development (Ghosh et al., 2021). Arriving at a shared vision demands broad

(considering the voices of different actors, acknowledging tensions between them) and deep (evaluating the quality and credibility of objectives) activities (Ghosh et al., 2021; Schot et al., 2019). Creating spaces to navigate expectations helps to overcome conflicts and open up different possible solutions sensitive to local environments (Ghosh et al., 2021). Directionality is specifically important in this outcome, as it involves prioritizing social solutions over development-oriented pathways (Schot et al., 2019). For The Ocean Cleanup, this outcome may present as conducting joint planning sessions with local partners to determine project priorities based on data and local knowledge.

2.3.2 Expanding and mainstreaming niches

Niches must grow in size and scale for transitions to occur. Such growth means that the new rules and practices within the niche are mainstreaming or becoming more accepted, thus also supporting their uptake in nearby niches (Ghosh et al., 2021).

2.3.2.1 Upscaling

Upscaling concerns the diffusion of the socio-technical system, meaning the niche becomes bigger or includes more actors. This outcome occurs via simple expansion or because the inter-niche boundaries become fluid. Upscaling presents a question for EPEs of how they can learn ways to upscale a niche or merge them (Schot et al., 2019). In The Ocean Cleanup, this represents its interest in deploying multiple Interceptor solutions within the same river or region, upscaling from a project to a programme. More simply, upscaling activities may also include adding new stakeholders to the consortium or engaging in communication and marketing campaigns to further diffuse the technology. Upscaling also goes beyond the technology, aiming for a larger uptake of policy measures or symbols, for example (Ghosh et al., 2021). This is showcased by a demonstrable adoption of river clean-up efforts, such as manual cleanup events, for example.

2.3.1.2 Replicating

Replicating involves expanding the niche geographically, reproducing or replicating it (or specific elements of it) in a different location (Ghosh et al., 2021; Schot et al., 2019). Replication does not imply the results yield similar niches, as niche building is place-based and thus sensitive to context specificities. It is possible that replication in a new location may lead to a different, more (or less) successful niche. Although contextualization is important for the success of the replication outcome, de-contextualization is also necessary to fulfill the process of expanding and mainstreaming niches, leading to broader socio-technical change (Schot et

al., 2019). De-contextualization means some elements of the system are versatile and replicable in new contexts. An example of this outcome in this study is The Ocean Cleanup's focus on projects in South-East Asia, hoping to build on the progress it has made in that region so far, further demonstrated by launching an Asia office.

2.3.1.3 Circulating

Circulating includes the cycling of ideas, people, rules, and products between niches. It focuses on de-contextualisation and re-contextualisation (Schot et al., 2019). An example of this could be appointing an intermediary actor whose role is to take teachings and circulate them to other experiments through training sessions or visits (Ghosh et al., 2021). In The Ocean Cleanup, this may take the form of someone in charge of training local operators of Interceptor solutions. The focus on spatiality and the role of actors in enabling circulation differentiates this TO from upscaling and replicating. By connecting niches from different contexts, this TO aids expanding the global niche (Ghosh et al., 2021; Geels & Deuten, 2006).

2.3.1.4 Institutionalizing

Institutionalizing involves creating a more lasting impression – meaning the emerging rules and norms in a niche become widely implemented and accepted. For this to happen, niche stakeholders must agree on the sets of definitions, regulations, and preferred types of behaviors to standardize via socialization processes, education programmes, protocols (Molas-Gallart et al., 2021; Schot et al., 2019). For The Ocean Cleanup, this could involve having an Interceptor operational agreement institutionalized, so the project is embedded within the participating institutions.

2.3.3 Opening up and unlocking regimes

Another key step in transitions is opening up and unlocking regimes. This provides niche innovations with the potential to expand. Alleviating the rigidity and closeness of the regime provides the opportunity for reconfiguration and destabilization, thus allowing for the expansion of the niche (Ghosh et al., 2021).

2.3.3.1 De-aligning and de-stabilizing

De-aligning and de-stabilizing means that multiple and/or significant environmental and/or social impacts have led the regime to become destabilized, allowing for a regime shift. A regime shift refers to changing paths and effecting new path dependencies, thus optimizing socio-technical change. Activities aspiring for this outcome should account for retraining and

convincing stakeholders of the opportunities that will arise through changing course to a more sustainable path (Schot et al., 2019). An example of this is The Ocean Cleanup convincing local actors of the potential benefits of upgrading existing waste management systems in supporting the transformative goal. Beyond the project and programme level (policy-mix level), this may involve placing pressure on governments to take action on plastic pollution (Ghosh et al., 2021).

2.3.3.2 Unlearning and deep learning

Unlearning and deep learning in regimes involves regime actors questioning their assumptions, beliefs, and values, developing new perceptions that support the transformation (Schot et al., 2019). The role of the policy actor is to facilitate regime actors in reassessing the regime rules compared to the new alternative rules for transformative change (Ghosh et al., 2021). For instance, if The Ocean Cleanup were to organize a policy lab contemplating the policy barriers for cleaning the 1000 most polluting rivers in the world. The new rules may create higher costs and other disruptions, so this TO also deals with accepting such risks, uncertainty, and costs (Schot et al., 2019).

2.3.3.3 Strengthening regime-niche interactions

Strengthening regime-niche interactions involves connecting the ideas and resources of niche and regime actors to make niches more competitive (Ghosh et al., 2021). In the context of The Ocean Cleanup, this may appear as a partnership with a local anti-plastic pollution NGO that uses The Ocean Cleanup's resources when conducting its own projects. Generally, activities to diversify the consortium or network engages this TO (Ghosh et al., 2021).

2.3.3.4 Changing perceptions of landscape pressures

Changing perceptions of landscape pressures entails shifting regime actor's understanding of the broader landscape pressures. There is little research on this outcome (Schot et al., 2019). However, perceptions of climate change can be used to exemplify this outcome. To illustrate, despite research pointing to the anthropogenic causes of climate change for several decades, many regime actors (i.e., large corporations) did not perceive this as a threat that impacts society (Schot et al., 2019). Social movements, for example, helped shift perceptions (Ghosh et al., 2021). It is interesting to see how this research elaborates on this outcome, as The Ocean Cleanup seeks out regimes that already have local knowledge and research pertaining to the riverine plastic problem.

3.0 Methodology

This section begins by describing the research design - introducing the guiding principles of the formative approach and providing background into the flexible Theory of Change. The rest of the section details the more explicit methods - data selection, data collection, data analysis and data validation - that were employed in this study.

3.1 Research Design

3.1.1 Formative approach to TIP Evaluation

A deductive, qualitative, and formative methodological approach is employed to address the research questions outlined in Section 1. A formative approach means that The Ocean Cleanup's TIP is evaluated as it is being implemented, providing observations that can be used constructively (Molas-Gallart et al., 2021). Deductively, this theory uses the TO framework. The research follows six guiding principles as presented by Molas-Gallart et al. (2021). The first five principles form an understanding of the manner and lens through which to approach the evaluation. The sixth principle presents a more concrete research design.

- 1) *A formative method of evaluation.* The primary aim of this evaluation is to improve the implementation processes for the EPEs with the help of the stakeholders. The assessment is reflexive in nature with the goal of aiding the mission initiator (The Ocean Cleanup) in the continued execution of its TIP or mission (Molas-Gallart et al., 2021). This principle also relates to the validation process, elaborated in Section 3.2.4.
- 2) *Combine the assessment with the policy design and implementation.* According to Molas-Gallart et al. (2021), learnings from the evaluation are integrated into the implementation of TIPs. For this research, this means concrete recommendations for The Ocean Cleanup (RQ2 and RQ3) are derived from the analysis. Recommendations are provided as insights in Section 5.0 and formulated as concrete recommendations for The Ocean Cleanup in the Executive Summary.
- 3) *Inclusive and participatory evaluation.* Stakeholders of TIPs are involved in their assessment. External experts, in this case the author of this thesis, are meant to facilitate participation and debate and identify when there are power imbalances or misalignments in perspectives and interests (Molas-Gallart et al., 2021).
- 4) *Combine methods and techniques.* The evaluation method is flexible and chosen based on the policy context (Molas-Gallart et al., 2021). This study employs qualitative methods to best capture the TOs and social impacts of The Ocean Cleanup's EPEs. To

do this, flexible theory of change (Principle six) and outcome harvesting (Section 3.1.3) are used.

- 5) *A nested approach multi-level TIPs evaluation.* EPEs operate at different levels (projects, programmes, and policy-mix), all of which are subject to assessment. Nested implies that the outcomes achieved at each level add to higher level accomplishments (i.e., plastic-free oceans). Put differently, niche projects, on their own, cannot generate impact that transforms the socio-technical system (Molas-Gallart et al., 2021). By evaluating EPEs at each level and making connections between dimensions, a nested approach is employed.
- 6) *Apply a flexible Theory of Change.* Expanded upon in the following section, 3.1.1.1, involves the following five elements.
 - a. **Context:** The socio-technical environment that affects transformation but is not directly addressed by the solution (Molas-Gallart et al., 2021). The process of assessing the context must be informed by what truly matters to the change environment (Hivos, 2015).
 - b. **Inputs:** All the available resources accessible to actors to enact change (Molas-Gallart et al., 2021). This includes the inputs supplied by the policy intervention (Hivos, 2015).
 - c. **Activities:** All the interventions involved in an EPE that are related to TOs, so they must be transformative. To simplify the research design, transformative activities and inputs are combined (Figure 2). This decision was made post-hoc, as the data collection provided few distinctions between inputs and activities.
 - d. **Transformative outcomes (TOs):** Refer to Section 2.3.
 - e. **Impact:** The creation of a new, sustainable socio-technical system that accomplishes the TIP targets. As per RQ 3, this research focuses on the social impacts of the EPEs. The following parameters are used to identify areas of (potential) social impact (Vanclay, 2003). It is important to remember that not all social impacts are transformative. Transformative social impacts are reported in text (Section 4.1). Further, only positive social impacts are reported, as The Ocean Cleanup is only interested in leveraging positive social change (RQ 3).
 - i. Changes to the ‘way of life’ of local people - meaning how they live, work, play, or interact daily.
 - ii. Changes to the culture of local people. Cultural changes may involve shared beliefs, norms, values, etc.

- iii. Changes to the local community in how it is structured, in its stability, or the services and facilities it provides.
- iv. Changes to local political systems. This concerns people's ability to be involved in decisions that impact them, the amount of democratization, and the resources allocated for this purpose.
- v. Changes to the local environment. Relevant examples include changes to local air and water quality; the level of exposure to hazard or risk; their physical safety; their access to resources; etc. As the primary goal of the river deployments is to change the local environment and this is already measured within The Ocean Cleanup, scoping this parameter mainly focuses on observations the organization does not consider (e.g., qualitative measures).
- vi. Changes to the financial wellbeing of local people.
- vii. Changes to people's fears and aspirations. For example, how they perceive their future safety and the future of their community, family, etc.

3.1.1.1 Understandings of a flexible Theory of Change

A Theory of Change usually starts with the policy stakeholders and determines the goals they wish to achieve via their solutions. Such goals are viewed as changes to the baseline solution. After establishing the changes, the organization wishes to achieve, the necessary preconditions for said change are identified (Molas-Gallart et al., 2021). However, since this study aims to understand the transformative success of The Ocean Cleanup's River Department in its current state, the intention of the Theory of Change is different and more post-hoc, rather than ad-hoc. This also relates to the flexibility of this approach, described below.

Hivos (2015) conceptualize Theory of Change as: (1) a way of thinking or overall approach, (2) a process resulting from an analysis, or (3) a product resulting from a process. A Theory of Change as a product (3) provides a basis for decision-making by depicting the change at a moment in time, aligning well with the more post-hoc methodology of this study. A flexible Theory of Change builds on this. The inputs, activities, TOs, and impacts are not thought of as fixed, but instead, as elements that can be returned to and redefined due to the formative nature of the evaluation. This is particularly useful in this context, as the transformative success (RQ 1 and RQ2) and the positive (transformative) social impact (RQ3) of the river deployments are unknown, and thus so is its understanding of the necessary preconditions for this change. The

flexibility of this approach allows these factors to be redefined as the impact is better understood.

Figure 2 provides a visual representation of the Theory of Change and the level of control The Ocean Cleanup has on each element. The three spheres represent control, influence, and interest. Conceptualizing EPEs this way helps to understand the EPEs influence in the change process and its achievement of desired results (Hivos, 2015), in this case socio-technical change. The sphere of control deals with aspects that are within the responsibilities of the EPE, so the inputs and activities and their direct results - the plastic extracted, for example. The sphere of influence is beyond the control of the EPE, but it encompasses the outcomes the EPE expects to see as a result of its activities (Hivos, 2015) - i.e., the transformative outcomes. For The Ocean Cleanup, influence can be direct (result of The Ocean Cleanup’s activities) or indirect (result of partners’ activities). The sphere of interest deals with sustained structural change - societal conditions are changed.

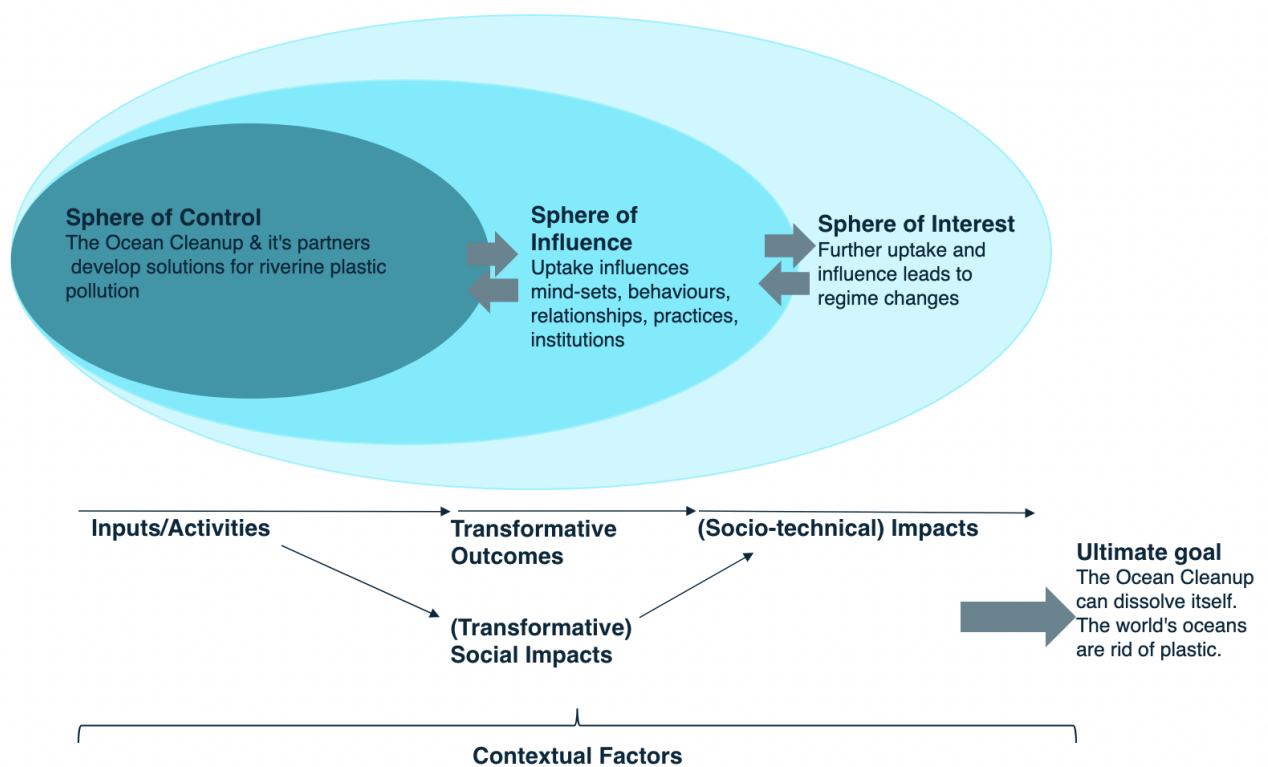


Figure 2: A visual representation of the elements of a Theory of Change and how they relate to the level of control The Ocean Cleanup (and its partners) has on each element (adapted from Hivos, 2015).

Figure 2 demonstrates that (socio-technical) impacts fall within the realm of interest, and are therefore, long-term changes that are not the result of one actor or activity (Hivos, 2015). Progressively over time, changes to the socio-technical system compound to result in

progress towards the ultimate goal of The Ocean Cleanup - to rid the world's oceans of plastic. Transformative social impacts are therefore not reported as resulting from outcomes, but rather as resulting from activities. This relationship is clearly depicted in Figure 2. See element 'e' above for the description of transformative social impacts.

3.2 Data

3.2.1 Cases

The study cases include one river project (USA), two programmes (Malaysia, Jamaica), and one policy mix (Dominican Republic), allowing for the comparison of transformational success of EPEs at different levels. All EPEs are in the operating phase, meaning the solution(s) are deployed. However, they do vary in the length they have been operational for, capturing EPEs at different stages (time element). Each selected EPE possesses unique characteristics and socio-technical contexts, which aid to understand the role of place specificity.

More specifically, these EPEs were selected based on their waste management infrastructure. Each EPE fits within a different categorization of The Ocean Cleanup's archotyping system¹. These waste management archetypes characterize the municipal waste management infrastructure (i.e., collection and transport infrastructure, waste recovery landscape, government involvement, awareness on plastic pollution, river cleanup priority) in The Ocean Cleanup's target countries. Waste management is a mid and upstream sector that influences The Ocean Cleanup's TIP or mission. From a theoretical standpoint studying different archetypes of waste management systems helps to understand the breadth of transition (Andersen et al., 2023) or the changes that are happening beyond the Interceptor. More specifically, waste management archetypes fall within the institutional dimension of the socio-technical system, as they guide the activities and perceptions of actors (Geels, 2004).

The EPEs also vary in terms of the types of stakeholders involved in their missions, their institutional structures, and the physical environment in which they operate. The overall objective of the EPE also varies between EPEs, although they all aim to reduce the amount of plastic flowing into the sea and validate the solutions applied. These differences (and similarities) are expanded upon in the case descriptions provided in their respective subsections in Section 4.1.

¹ Waste Management Country Archetypes: A = Mature & Organized; B = Maturing & Inefficient; C = Slowly Maturing & Informal; D = Distressed & Mismanaged.

3.2.2 Data collection

Data is collected using a combination of desk research and interviews with relevant stakeholders. Interview data aims to fulfill the third principle, *inclusive and participatory evaluation*. This study conducts at least one interview with every stakeholder listed for each selected project, programme, and policy mix (Figure 3). Desk research consults The Ocean Cleanup’s internal documents, The Ocean Cleanup’s external documents (e.g., social media posts, podcasts, etc.), and news articles.



Figure 3: Overview of the selected interview participants for each EPE. Participants marked with a ‘*’ were optional, their interviews were based on the recommendations of each project lead.

The data collection focuses on gathering information pertaining to the transformative outcomes (RQ 1 and 2) and (transformative) social impacts (RQ 3). To fulfill Principle six of the formative approach - *apply a flexible Theory of Change* - data is also collected on the context and inputs/ activities that lead to the transformative outcomes and (transformative) social impacts. Generally, data collection begins with conducting desk research (i.e., consulting internal documents), using this information to formulate interview questions. To ensure that the data collection focuses on the transformative aspects of these aspects, outcome harvesting is employed.

Outcome harvesting gathers evidence of change (a.k.a TOs and social impacts) and then works backwards to understand if and how an activity has contributed to specific changes. This

methodology is particularly useful when wanting to understand the effectiveness of an activity, the process of change, and how each outcome enhances this change (Wilson-Grau & Britt, 2012). This methodology is utilized both for data collection and data analysis.

In the data collection phase, outcome harvesting is used to construct the interview guide. The interview guide is divided into two main parts - one focused on transformative outcomes, the other focused on social impacts. Both sections focus first on identifying whether the TO or social impact is present (via outcome harvesting), then on the inputs/activities and contextual factors that contribute to realizing these outcomes. An example interview template is provided in Appendix A. The TO interview questions were largely derived from Schot et al. (2019), with some input from Ghosh et al. (2021). The guide serves as a template to facilitate semi-structure structured interviews. Further, interview questions are adapted for each participant based on the EPE, their position and affiliation, and on the information gathered in past interviews. After interviews are conducted, audio files are transcribed and uploaded to NVivo software for analysis.

3.2.3 Data Analysis

Interview transcripts and excerpts from desk research are coded using Nvivo software. Data is input into the software corresponding to its EPE (USA, Malaysia, Jamaica, and DR). The coding process is primarily deductive and hierarchical in nature. Deductive meaning that the analysis begins with a pre-existing set of codes that the new qualitative data is assigned to. These sets of codes are the twelve TOs and the seven (transformative) social impact dimensions. Themes outside of the pre-existing set of codes that arise when coding are accounted for. For example, an additional parent code entitled ‘General’ is created to categorize interview statements that were more general to The Ocean Cleanup, rather than to specific EPEs. This has implications for the general, flexible Theory of Change, described in more detail in Section 3.2.3.1.

The hierarchical scheme aids in organizing codes in relation to each other (Chi et al., 2004). This process follows outcome harvesting (Section 3.1.2). First, the transformative outcomes and social impacts are identified, along with their contributing inputs/activities. Working backwards, contextual factors are also identified. To help with the coding process, a summarized table of the transformative outcomes was used as a reference tool (Appendix B).

After the transcripts are coded, coding files are extracted, and further interpretation is done in Miro Board. Here, the qualitative codes are condensed and summarized, mapping out the transformative outcomes and (transformative) social impacts in relation to the

inputs/activities and overarching contextual factors - applying the *flexible Theory of Change*. This methodological step is described in more detail below (Section 3.2.3.1).

3.2.3.1 Analytical application of a flexible Theory of Change

3.2.2.1.1 Case-specific Theories of Change

First, specific Theories of Change are constructed for each EPE. This study follows the three steps proposed by Molas-Gallart et al., (2021), to construct four specific Theories of Change, one for each EPE:

- 1) Determine the level of EPE and the primary stakeholders. Recall from Section 2.2, these are:
 - a. Projects: This includes the individual deployment initiatives in each river.
 - b. Programmes: Programmes are multiple river projects in the same river or region.
 - c. Policy mixes: This involves partnerships with organizations that tackle more systemic causes of riverine plastics, like The Ocean Cleanup's alliance with UNDP (Section 4.1.4).
- 2) Describe the elements (Section 3.1.1: a - e) of the evaluation. As there was much overlap between different elements of the Theory of Change, specifically within the identified contextual factors and activities, these were grouped together into common themes. This was an iterative process and mainly served to simplify results. The makeup of these themes is made explicit for each EPE in Section 4.1. Specific attention is placed on ordering the activities in chronological order. This serves to understand how The Ocean Cleanup (and its partners) has prioritized certain activities (and subsequently TOs and social impacts) and/or adapted its approach over time.
- 3) Map the change pathways for each EPE. This step involves defining the linkages between the five elements described in Section (3.1.1.1). Many assumptions are generated via this step. Assumptions are made when linking transformative activities/inputs to relevant contextual factors. These assumptions are validated (Hivos, 2015) and are described in Section 3.2.4.

The results of these analyses are presented in the respective case-specific results section (Section 4.1). This addresses RQ 1, and provides the basis for answering RQ 2 and RQ 3.

3.2.2.1.2 Generic Theory of Change

Next, the context specific elements identified are reconceptualized and made more generic. The purpose of this is to understand the (current) pathways of transformative change in The Ocean Cleanup's River Department, drawing connections from the four EPEs. This is done by first mapping the 'General' codes from NVivo into Miro Board (following the same three steps detailed above). Connections are then made across EPEs, utilizing outcome harvesting again to first look at each transformative outcome and social impact and then make connections between similar contributing inputs/ activities. Again, this is done iteratively in Miro Board. Section 4.2.1 presents the generic, flexible Theory of Change as a product.

In summary, this study produces five Theories of Change as products: four specific ones for each EPE and one general one. In executing this analysis, the research questions are addressed. Following Molas-Gallart et al (2021)'s formative approach, aids in identifying the transformative outcomes present in The Ocean Cleanup's river deployments (RQ 1). In linking these outcomes to the different elements (contextual factors and input/activities), The Ocean Cleanup can leverage this knowledge to enhance the TOs of existing and future river deployment, thus, answering RQ 2. RQ 3 is also addressed by following this approach and identifying the (transformative) social impacts.

3.2.4 Data Validation

Data is validated in the following ways:

- Purposeful sampling strategy. Used to select EPEs (different levels and contexts) and interviewees (including a wide-range and acquiring via recommendations) ensures the replicability of this study (Thyer, 2019).
- Data triangulation.
 - Data collection via multiple methods - interviews and desk research.
 - Combining the formative evaluation method with process tracing (Thyer, 2019).
- Peer debriefing. Interpretations are shared with supervisors from the University and The Ocean Cleanup (Thyer, 2019). For The Ocean Cleanup, this takes the form of data validation sessions with internal members of the EPE team, where results are shared, and assumptions made explicit. The team provides feedback and clarity on the topics raised in the session.

4.0 Results Overview

As described in Section 3.2.2, data was collected using various mediums, with interviews being the primary data source. Table 1 provides an overview of the data per EPE. In total, 29 interviews were conducted with 35 participants.

Table 1: Overview of data sources per EPE. Appendix C includes a more complete list of ‘Other’ sources.

EPE	Interviews			Other	
	Internal	External	Total	Internal	External
USA	6	0*	6	Summarized ESIS report***; Team meeting powerpoints; Project summary document	4 ‘Interceptor Pilot Project Community Meeting’ presentations; 8 Instagram posts (via primary partner)
Malaysia	8	2 (5 participants; 3 & 2)	10 (13 participants)	Summarized ESIS report; Project summary document; Website articles	Instagram post by President Anwar Ibrahim; SMG website; News articles
Jamaica	5	1 (2 participants)	6 (7 participants)	Summarized ESIS report; Project summary document; 3 Quarterly Reports (produced by the primary partner); 2 Youtube videos; 1 Podcast; Website articles	6 Youtube videos; News articles
DR	5	1 (3 participants)	6 (8 participants)	Summarized ESIS report; 2 Podcasts; Project summary document; Rescate Ozama Programme document; Website articles	News articles

General	1**	n/a	1	n/a	n/a
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*No external interviews were conducted with external partners from the USA EPE. This is because of internal policies associated with the primary partner being a public entity (Section 4.1.2).

**One interview was conducted with the Director of the River Department.

***Summarized ESIS report: These are summarized Environmental and Social Impact Statements.

The results are split into two main parts, one focusing on the results for each individual EPE (Section 4.1) and another centering around a cross-comparison of all the results (Section 4.2). Table 2 presents the main themes of activities that support each TO per EPE. Themes were created iteratively and post hoc to simplify the extensive amount of data.

4.1. Case-specific results

Case-specific results are presented in the following subsections. Case descriptions provide pertinent information regarding the solution(s) deployed, timeline, key stakeholders, project objectives and other important descriptors. It is important to note that the relevant contextual factors for the EPE are also presented in the case description (although are linked more clearly to activities, outcomes, and impacts in the specific Theory of Change Section). All EPEs contain enabling stakeholders like sponsors, manufacturers, and mandators, as well as executing stakeholders like operators, recyclers, and owners/project facilitators. To avoid repetition, only the owner/ project facilitators are described in detail, referred to hereafter as the primary partner. Other relevant stakeholders are discussed throughout the results as needed.

The transformative outcomes and (transformative) social impacts are grouped according to the themes of inputs/activities (primarily focusing on themes of activities) and presented in chronological order in the second subsections - ‘Transformative outcomes & social impacts.’ In text, transformative outcomes are *italicized*, transformative social impacts are *underlined and italicized*. It is also worth noting that in some cases, TOs and transformative impacts are potential and not realized. These instances are noted by putting asterisks on either side of the *word*. Although important to include in text, as they relate to the ambitions of The Ocean Cleanup, these potential outcomes and impacts are not reported in Theory of Change figures (Figures 5 -9).

The final subsection for case-specific results, presents the specific Theories of Change as a product per EPE. The key contextual factors that were identified via outcome harvesting

and applying the flexible theory of change (Section 3.2.2) are discussed here. Initial case-level insights are also discussed.

4.1.2 Project level: USA

4.1.2.1 Case description: USA

The Ballona Creek project in Los Angeles, USA, referred to hereafter as the USA project, consists of one Interceptor Original (Generation 3) (Figure D.1; Appendix D). The project was initially set to begin in 2019, however, due to COVID and technical delays, the system launched officially in October 2022 and is piloted for two storm seasons, spanning over two years. Storm seasons set the trial period. This is because Ballona Creek is a man-made canal that experiences the majority of plastic flux from land to the ocean during the rainy season, which lasts from October to April. April 2023 marked the end of the first storm season. Other unique physical characteristics of this location include it being located in a tidal area with a rocky shoreline. This allows The Ocean Cleanup to test the Interceptor technology in such an environment.

The Ocean Cleanup is the project initiator and (current) project owner. The operator and primary partner is a government entity. If the trial period is successful, the Interceptor will be donated to the local partners, and they will take full responsibility of the project.

The LA project is a unique project location choice for The Ocean Cleanup. Firstly, it is situated in a Class A municipal waste management system, meaning it is mature and organized. It also does not belong to the 1000 most polluted rivers globally, but it does enable The Ocean Cleanup to make progress towards their core mission. To elaborate, this project represents a good funding opportunity for The Ocean Cleanup, as it is strategically located close to funders and is situated along a very popular beach. Further the community profile, or characteristics of the community living nearby to the Interceptor is also influential. Notable characteristics of the community include participatory (i.e., engaged and active), environmentally conscious (e.g., aware of environmental issues, and already taking actions to support the environment), and wealthy (e.g., expensive homes near the Interceptor).

4.1.2.2 Transformative outcomes & transformative social impacts: USA

The following section describes the *transformative outcomes* and (transformative) social impacts present in this project, grouped by most relevant themes of activities and ordered chronologically.

- **Community approval:** There are several project activities that center around receiving approval and alignment from the public. Prior to launching the solution, this was a necessity - as the community living near the Interceptor is very concerned with projects that might affect their homes. These activities include hosting community-based information nights and erecting information boards at the site. Firstly, the primary partner hosted several community-based information nights that provided information on the project, answered concerns, and offered opportunities to directly ask questions. These *shielded* (deeply) by helping to create a context where the public was onboard with the project. The information sessions also *networked* (deeply) by enhancing trust between locals and the primary partner, and *navigated expectations* (broadly) by allowing locals to voice concerns. The primary partner also placed information boards at the site of the Interceptor. This serves a similar purpose (*shielding*) by keeping the community aware and by mitigating misunderstanding, although representing more of a broad shielding as the activity is both passive and active. These boards raise awareness of the problem within the community, contributing to changing the culture of the community.
- **Technology testing:** Transformative activities relating to the technology itself are present in *learning* and *circulating* outcomes. These activities, expanded upon below, center around working sessions between the people using this technology. *Learning* (deeply) is enabled through working sessions on the Interceptor Original (Generation 3) which involve all stakeholders using the technology (e.g., operators, manufacturers, engineers) where everyone shares their lessons learned. These sessions also represent a *circulating* activity as the technical lessons learned are shared with actors across multiple niches, specifically between USA and Malaysia, which both have the Interceptor Original (Generation 3).
- **(Environmental) impact monitoring:** Impact monitoring activities represent the *learning* (broadly) outcome. Monitoring efforts involve multiple actors (university partner) and multiple dimensions. Societal and environmental dimensions or impacts are directly captured through these efforts. Market and user preferences are also addressed, as the public desires project transparency (see ‘Community approval’).
- **Engaging new stakeholders:** New stakeholders are added to the network behind the Interceptor, primarily *upscaling* the reach of the project. The collaboration between a prominent, local Yacht Club facilitated much of these activities. Through this partnership, The Ocean Cleanup can utilize their boats and reception space. First, this

shields (deeply) the project, as by using the Yacht Club's boats, The Ocean Cleanup can save costs on boat rentals and reception spaces. Being able to use these resources, makes it easier for The Ocean Cleanup to *upscale* the project further. The Earth Day Campaign with a global video game company is also an example of this. This campaign raised funds (*shielding*) for The Ocean Cleanup on Earth Day by sharing a video of the mission of the USA project, promoting its customers to donate. Such a collaboration *strengthened regime-niche interactions*, as the resources (e.g., international reach) of the video game company are connected to the mission of The Ocean Cleanup. This Earth Day campaign also connects to 'Media attention', the next activity theme.

- **Media attention:** The media attention the USA project receives *upscales* the project and the ideas of The Ocean Cleanup immensely. Such attention is prompted by The Ocean Cleanup, the primary partner, but also by unrelated outlets. An interesting example of how media attention promoted the project, was a side-by-side picture posted by the primary partner that showcased the plastic on the beach after a storm event pre- and post- Interceptor deployment (Figure 4). This photo visually shows the changes to the *local environment*. Appendix C provides a list of additional media attention for the USA project. The media attention results in the increased adoption of users. For example, The Ocean Cleanup has received requests for Interceptors in other municipalities across the USA. Although these municipalities may not receive an Interceptor from The Ocean Cleanup, it still demonstrates the *upscaling* of the concept of the Interceptor and the power of media attention that surrounds it.

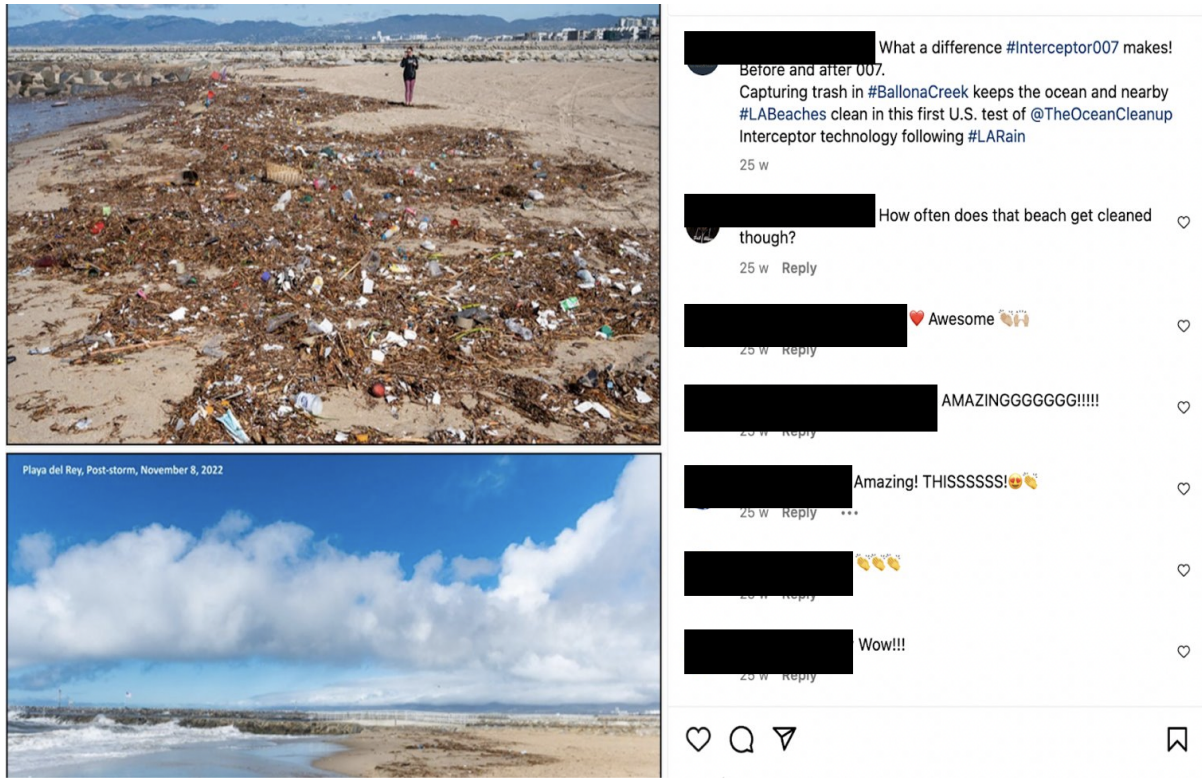


Figure 4: Images taken of the beach in Playa del Rey after storm events. The top image was taken prior to the Interceptor deployment, and the bottom picture was taken after the Interceptor deployment (Source: Instagram).

4.1.2.3 Theory of Change: USA

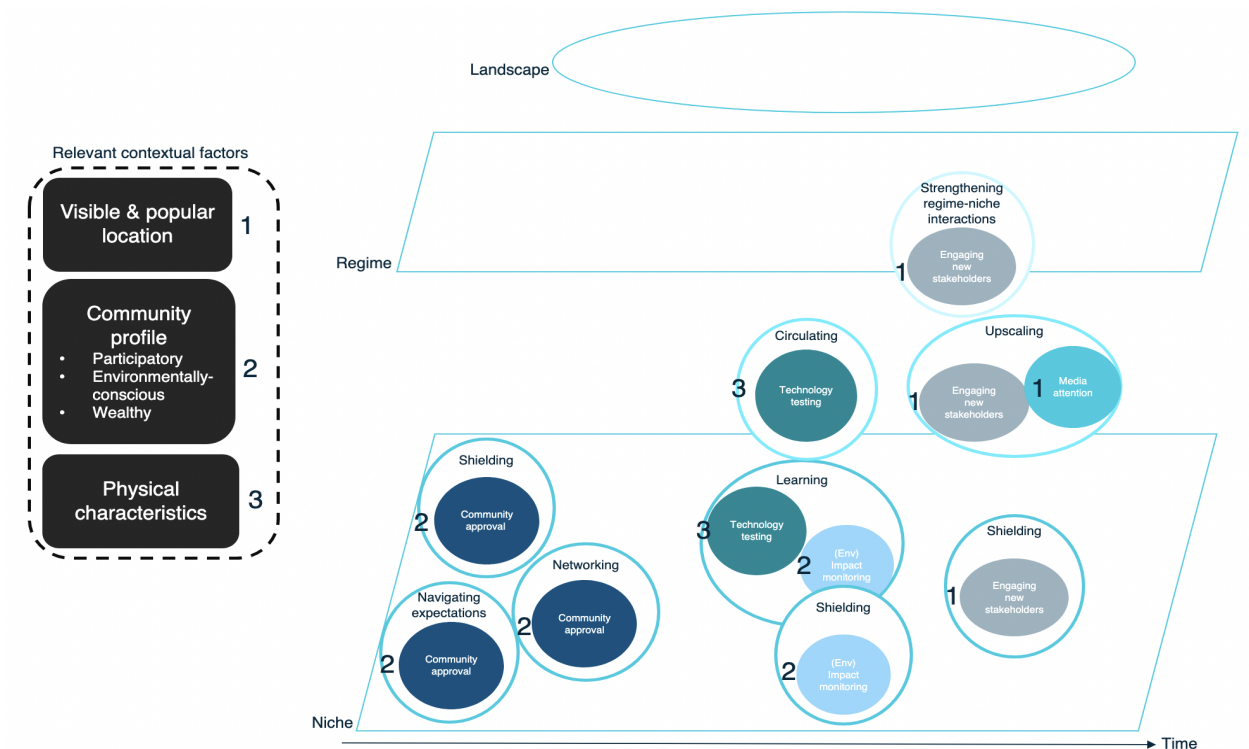


Figure 5: USA's Theory of Change as a product. Time is included along the horizontal axis to situate the themes of activities over time.

Figure 5 demonstrates that activities that support ‘Community approval’ and ‘Media attention’ result in the most transformative outcomes. The former activity theme being more impactful at the niche level - helping to build and nurture the environment for the Interceptor to thrive. The latter activity theme, influencing higher level TOs - helping to expand the reach and impact of the project to the regime. These categories of activities also result in the most (transformative) social impacts.

Lastly, considering the chronological order of these activities, Figure 5 demonstrates that in this project, activities that help ‘build and nurture’ the niche are the primary focus. Over time, higher level TOs begin to occur. These higher-level TOs, specifically attached to ‘Media attention’ activities are most closely related to realizing the funding opportunities of this project. As mentioned in the case description (Section 4.1.2.1), this is the key aspect of this project that contributes to achieving the overall goal of the River Department. Therefore, transformationally speaking, this project is already successful.

4.1.2 Programme level: Malaysia

4.1.2.1 Case Description: Malaysia

The Klang River EPE in Kuala Lumpur, Malaysia, referred to hereafter as the Malaysia programme, employs the same solution as the USA project - the Interceptor Original (Generation 3). It also deploys an Interceptor Original (Generation 2), making it a programme-level EPE. Descriptions and images of the Interceptor Original are provided in Figure D.1; Appendix D. The programme was initiated in 2019 with Generation 2, with Generation 3 being added in 2021.

The programme is owned and operated by a private company that was appointed by the Selangor State Government in 2018 to clean the Klang river. The primary partner is currently a for-profit firm, however, initially it was a government-sponsored organization. The overarching programme is the Selangor Maritime Gateway (SMG) programme, which has activities related to river cleaning (e.g., Interceptors, log booms, water quality monitoring systems), rehabilitation and beautification (e.g., flood control, bridges, etc.), development (e.g., mangrove point, community river park, etc.), and service projects (e.g., water taxi). The two Interceptors supplied by The Ocean Cleanup, only represent one river cleaning solution. The range of solutions implemented by the SMG programme emphasize the complexity and multi-faceted problems the Klang river faces. These extend beyond legacy plastic pollution and encompass flooding and poor water quality, for example. It is important to understand that The

Ocean Cleanup is not acting as the initiator of the wider SMG programme. This likely has implications for the direction of the programme, and subsequently its transformative success.

The municipal waste management system in Klang is classified as B - Maturing and inefficient. However, there is no suitable sorting center available to process the catch from the Interceptors. From the perspective of The Ocean Cleanup, the overall objective of this programme is to reduce the amount of floating plastic in the Klang. Beyond this, the programme aims to use data to drive improvements to the current solutions, employed by both The Ocean Cleanup and other SMG stakeholders.

4.1.2.2 Transformative outcomes & transformative social impacts: Malaysia

Five main themes of transformative activities are identified for the Malaysia programme. They are presented below in chronological order.

- **Partner alignment:** Activities that support partner alignment are paramount to the transformative success of this EPE. Without this alignment, the primary partner has historically prevented The Ocean Cleanup from participating in different upscaling projects (e.g., log booms²), demonstrating the importance of this outcome towards the *shielding* (broadly) and *networking* (deeply - developing mutual trust) outcomes. Activities that support this include having a local operator (liaison between operators, maintenance people, The Ocean Cleanup, the primary partner), conducting internal training on cultural awareness, and opening an Asia office (have more people locally). Launching the Asia office, also promotes the *circulation* and *replication* of learnings (e.g., stakeholder relationships, Interceptor performance) from the Malaysia programme to other Asian contexts.
- **Monitoring:** Activities centered around monitoring result in transformative outcomes. Monitoring activities include environmental monitoring and monitoring the plastic characteristics in the Klang. Progress meetings where monitoring results are shared are also captured in this theme of activities. Both monitoring activities result in *learning*. Environmental monitoring, specifically, has resulted in *learning* (broadly) as The Ocean Cleanup uses a university partner to learn about the environmental impacts of the Interceptor, while also learning about other uses of the river (e.g., the resources it provides to communities). Such knowledge is meaningful, as for the university partner, this has changed its perception about the river: the river has more life and supports more

² Log boom: a barrier placed in a waterway to collect floating debris.

activities than initially thought given the river's poor water quality classification. This also represents a **potential cultural** shift if this learning is shared. The environmental monitoring further enables *networking* (broadly), as the university team takes a lot of initiative within the consortia. For example, they share research findings and emphasize the importance of preserving the Klang River directly with the primary partners in progress meetings. Monitoring the plastic behavior within the river captures *learning* (broadly) as it emphasizes the efficiency of the solutions and where future efforts should be focused. This data is also used to *navigate expectations* (deeply) by providing credible expectations about landscape pressures, specifically with regards to the state of plastic pollution in the Klang. This information is shared with the primary partner in progress meetings. These monitoring activities influence future activities that relate to 'Community focus' and 'Solution portfolio development' discussed below.

- **Community focus:** Over time, the importance of the community towards the transformative success of this project has become clearer, and therefore has become more emphasized. The role of time and experience was paramount to the primary partner *learning* (deeply) of the importance of the community, and thus integrating more community-centered activities into the Selangor Maritime Gateway programme. Such activities include parks and mangrove sites, water taxis around the Interceptor, and zero waste campaigns. These activities *upscale* or draw awareness to the EPE and its ideas, while also positively changing the services provided by the *local community*. The water taxis, run by the primary partner, also *strengthen regime-niche interactions* by teaching about the historical relevance of the Klang and importance of this programme to large organizations and prominent regime actors (e.g., the Royal Family of Selangor). Again, this aids in promoting the programme itself, while also encouraging the re-assessment of regime rules and a *cultural* shift. Another interesting component of the water taxis are the *financial* benefits to local fishermen and businesses. Its boats are used to conduct the trips, which they receive compensation for. Further, there is a designated area where they sell local products between one of the Interceptors and the mangrove point. Such activities are helpful during the wet season, when it is more challenging to go to the sea to catch.
- **Waste management planning:** The importance of having a dedicated sorting center for the intercepted catch is something that was realized over time, representing a second-order *learning* in this programme. Although not built yet, there are several planning activities that foster TOs. These include workshops with the primary partner

and adding to the consortia. *Networking* (broadly and deeply) is enabled as the joint workshops represent activities where ideas and resources are shared. Further, involving the primary partner in the decision-making process empowers them to take more ownership of the project, ensuring the stability of the actor-network over a longer time. Waste management activities also support the *upscaling* outcome. It does so by adding actors to the consortia, namely it aided in developing a partnership with one of Malaysia's biggest conglomerates and an organization funding SMG's log boom solution. This conglomerate was previously uninterested in collaborating with The Ocean Cleanup until a business case was developed for a new sorting center. Once built, this sorting center can help to facilitate several potential transformative social impacts, such as changes to the **local community** and **financial** benefits.

- **Solution portfolio development:** An integral part of the transformative success of this programme is the portfolio of solutions employed to tackle plastic-pollution in the Klang. Activities that fall within this theme include the log boom study and workshops with the primary partner. Relating this to 'Partner alignment' and 'Monitoring', offering alternative solutions *shields* the programme by responding to concerns over the efficiency and business case of the Interceptors. This is also a significant *learning* (deep) of this project - the Interceptor is not a one-size fits all solution. Such learnings have resulted in The Ocean Cleanup reevaluating its approach - focusing on improving the business case of the programme and learning from existing solutions and expertise in the Klang. This *learning* has sparked other activities that focus on expanding the portfolio of solutions. For example, The Ocean Cleanup is conducting a log boom study, testing the efficiency of the pre-existing ones, and offering solutions where fit, with the ultimate goal of improving catch. Further, *networking* (broadly) is enabled via workshops with the primary partner (similar to the sorting center ones) that combine data collected by The Ocean Cleanup ('Monitoring') but use the primary partner's knowledge as engineers and locals to shape the direction of the project. The log booms (and other potential solutions) *upscale* the project as well. New stakeholders, like Malaysia's largest conglomerate (owner of existing log booms; see 'Waste management planning'), are added. This example points to the *networking* ability of the projects. Once implemented, learnings about these solutions will be **circulated** and **replicated** (if positive) across teams and EPEs within The Ocean Cleanup, as log booms are simpler, cheaper, and a widely implemented solution in Asia.

- Showcase piece:** The overall catalyzing power of the Interceptor itself sets many TOs in motion. This is exemplified via external social media posts, partnership agreements, and visits to the Interceptors with government bodies. For example, Malaysia President, Anwar Ibrahim, posted about the Interceptor on his social media page, *upscaling* the reach of the EPE (See Appendix C for the post). The mobilizing power of the Interceptor also prompted the primary partner to sign a partnership agreement for four other rivers in Malaysia, a first step towards **replicating** this EPE more concretely. Site visits to the Interceptor with government bodies (e.g., Ministry of Environment) interested in flood mitigation measures also drives potential policy (**de-aligning and de-stabilizing**) and potential funding (**shielding**), overall *strengthening regime-niche interactions*.

4.1.2.3 Theory of Change: Malaysia

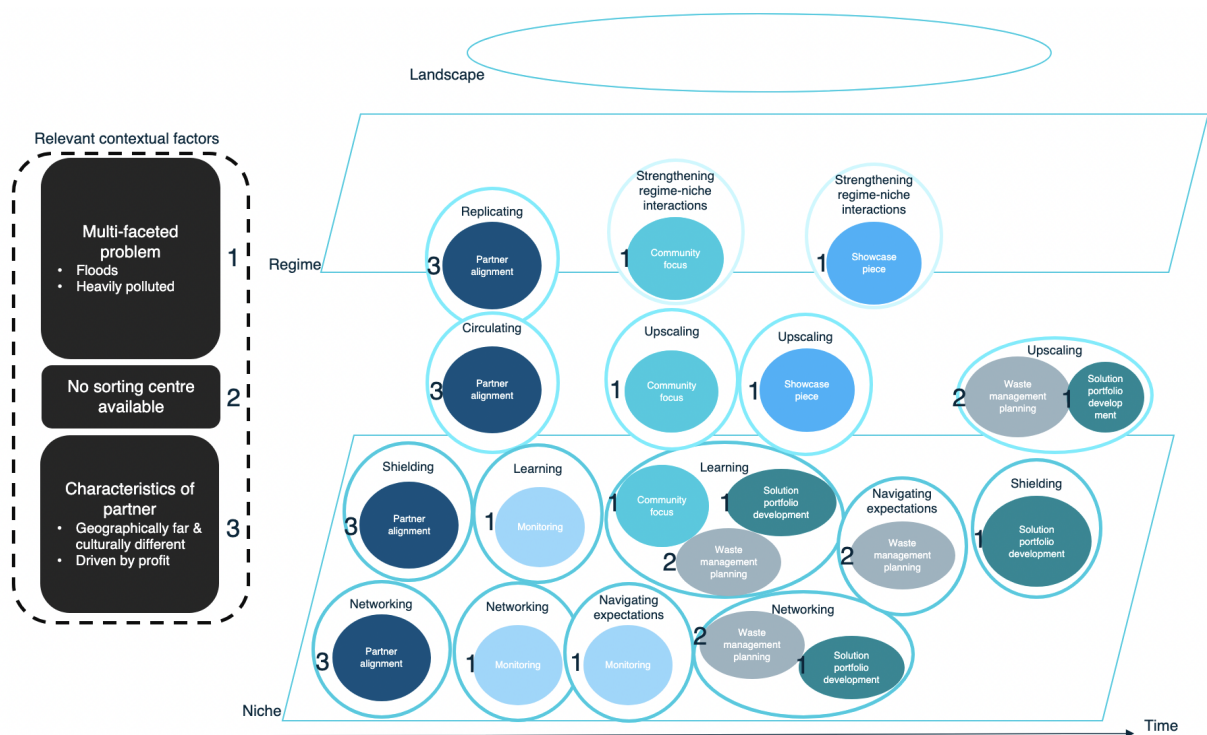


Figure 6: Malaysia’s Theory of Change as a product. Potential (but not yet realized) TOs are not included in this figure. Time is included along the horizontal axis to situate the themes of activities over time.

Figure 6 demonstrates the characteristics of the partner, most specifically the fact that they are largely motivated by profit, has implications for TOs on every level. Temporally, this realization or the importance of aligning with a partner with these characteristics, heavily influenced other transformative activities (‘Solution portfolio development’) or, more broadly,

the transformative success of this programme. It is important to note that activities related to ‘Waste management planning’ and ‘Solution portfolio development’ are not entirely realized at the time of this study but are rather prospective outcomes of current *learning* and *networking* activities. The final contextual factor - the multi-faceted nature of the problem’ is also connected to TOs across every level and is more prevalent in recent activities - pointing to the significant *learning* happening in this programme.

As The Ocean Cleanup is not the mission initiator of this programme (Section 4.1.2.1), activities like ‘Partner alignment’ are likely more important at the onset of the programme, as is showcased in Figure 6. This also puts more pressure on The Ocean Cleanup to partake in ‘Solution portfolio development’ activities. However, The Ocean Cleanup seems to take more initiative with regards to providing information, via ‘Monitoring’ activities, which also influence ‘Waste management planning’ and ‘Solution portfolio’ activities. Overall, this programme demonstrates quite a few transformative across the niche and regime level, with a broader range of transformative activities happening over time.

4.1.3 Programme level: Jamaica

4.1.3.1 Case description: Jamaica

The Ocean Cleanup’s river deployment in Kingston Harbour, Kingston, Jamaica (aka. Kingston programme) is a unique deployment for several reasons. Firstly, it does not employ any Interceptor Original solutions, but rather several Interceptor Barriers and Interceptor Tenders (Figure D.2; Appendix D). Different solution technologies were selected here because the EPE aims to address eleven gullies, each in different communities with different environmental aspects, leading to the Kingston Harbour, making it a programme. Currently the programme has operational technologies in six gullies, initiating the first intervention in early 2022, and is planning to expand to six more gullies by the end of 2024. A key aspect of this programme is the fact that Interceptor deployments are situated in communities.

In this programme, The Ocean Cleanup acts as the initiator and owner. The primary partner is a charitable organization that supports its parent organization, a massive and influential conglomerate in the Caribbean. They act as the project facilitator - managing funds and assets. It is also important to note that community outreach is embedded in the project, and also enacted by the primary partner. The Ocean Cleanup does not directly participate in these activities. Other actors within the consortia are also noteworthy, described in more detail below (see ‘Contractual obligations’).

The municipal waste management system in Kingston is rated as Class C, it is slowly maturing and informal.

4.1.3.2 Transformative outcomes & transformative social impacts: Jamaica

Four main themes of transformative inputs/activities are identified for the Jamaica programme. They are presented below in chronological order.

- **Contractual obligations:** The contractual obligations of the programme are inputs that help it achieve several transformative outcomes. Firstly, the division of roles between stakeholders is unique in this project. As mentioned above, the primary partner manages funds, assets, and legal aspects - proving to *shield* (deeply) this niche. The primary partner can use its local knowledge to account for the island economy and source locally, leading to positive *financial benefits*. Next, programme funds are managed to *shield* the programme broadly, as the programme unlocks funds as operational KPIs are achieved. The operator has strong port authority and knowledge of administrative sourcing, etc. Recycling is handled by a local partner dedicated to providing recycling solutions in the Kingston region. Embedded within the project, a requirement of the primary funder, is to conduct community outreach activities (see ‘Community outreach’). This collaboration, bringing together different perspectives and skills exemplifies *networking* (broad).
- **Iterative approach:** Implementing solutions in six gullies around Kingston Harbour requires an intentionally iterative approach, triggering transformative outcomes along the way. Captured within this iterative approach is the stage-gate process and quarterly retrospectives. The stage-gate process ensures that before a new solution is deployed, it must go through a series of steps, ensuring a variety of aspects are fulfilled. This is interesting transformationally, because it ensures *replication* is happening properly. Each gully must go through the same steps to reach deployment (de-contextualization), that are tailored to that specific deployment location (re-contextualization). Additionally, undergoing this process involves all stakeholders in creating opportunities for challenging assumptions on how to best proceed with deployments, embedding *learning* (broadly) into the programme design. Additionally, *networking* (broadly) is enabled by utilizing local knowledge (e.g., what technology and where) to refine proposals. Inherently, this stage-gate approach *upscales* the programme - disseminating solutions to several gullies.

This EPE also holds quarterly retrospectives which are working sessions with the primary partner and the operator to reflect on the programme and future challenges and opportunities. These retrospectives are a chance to strengthen the *network* (deeply and broadly). Broadly, allowing all key partners to reflect on technological and operational challenges. Deeply, enhancing mobilizing power, mutual trust, and coordination among the actors involved in the niches. These sessions also aid in *navigating expectations* (broadly) as project priorities are set collaboratively. For example, in one retrospective session, the consortia decided the drivers of successful deployments are (in order from most to least important): 1) working collaboratively as a team; 2) effectively engaging communities and stakeholders; and 3) fostering government relations. This example showcases the ability of these retrospectives to develop shared directionality.

- **Community outreach:** Community outreach activities are embedded in the project, which have transformative implications for the programme. Community outreach activities include consultations with the community, school tours, and beach cleanups. Consultations happen with community leaders prior to each deployment, creating opportunities to *learn* (deeply). Such a *learning* ensures that jobs are created for members of that community - creating a positive *financial* change. Supportive cultural meanings and symbols are *upscaled* within the community. One example of this are school tours at the offloading site. UNICEF also partnered with GKF for this endeavor, adding a new stakeholder (*upscaling*), acting as an intermediary to *circulate* ideas that support the mission. Beach cleanups are another important activity to the transformative success of this project, *upscaling* the cultural meanings and symbols of this project to the actors involved. These events always involve different stakeholders from the government, private sector, community organizations, students, and from international events, thus creating clear connections between regime and niche actors, *strengthening regime-niche interactions*. Overall, these community engagement activities stimulate local awareness and education around the issue leading to positive *cultural* change.
- **Inspirational ability:** This EPE is inspiring niche, regime, and other local stakeholders, positively changing their *fears and aspirations* on the issue. One example of this is the primary partner having local stakeholders who are associated with different, non-related niches looking to the level of government cooperation and the processes that support this as a blueprint for its activities. Such level of cooperation is unique, and thus also facilitates a unique *circulating* outcome. Moving more to the technology itself, *unlearning and deep learning* is happening at the regime, although indirectly.

Interview data suggests that the Interceptors show authorities that tackling the problem is possible from a systems engineering perspective. This is exemplified by a quote from the primary partner of this EPE:

So that's one of the things our authorities have told us is that they found the problem so insurmountable... A systems engineering perspective breaking it down showed them that things were possible to do right. And so that's an important contribution of how this project is going to be like a catalyst.

4.1.3.3 Theory of Change: Jamaica

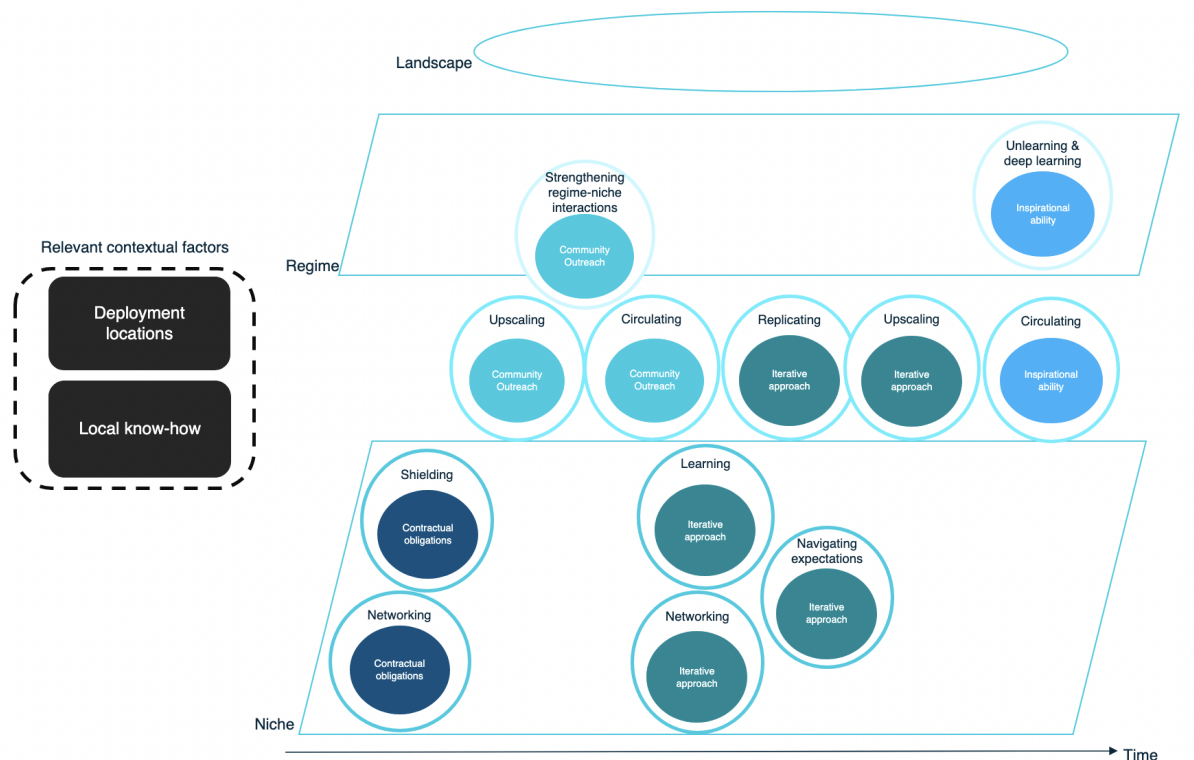


Figure 7: Jamaica’s Theory of Change as a product. Time is included along the horizontal axis to situate the themes of activities over time. Contextual factors are not labeled and attached to the activity themes because the both of relevant contextual factors influence relate to most of the activity themes.

Figure 7 demonstrates that place-specific factors like local know-how and the deployments being located in communities heavily influence the TOs observed in this programme. From the onset of the project, ‘Contractual obligations’ help build the niche, leading to higher-level outcomes by embedding ‘Community outreach’ activities into the programme; while ‘Iterative approach’ activities help nurture it.

Overall the embeddedness of community into this programme is clear, and helps foster TOs - this is not something that has to be learnt over time. Time does showcase how activities

associated with the ‘Iterative approach’ become more transformative as the programme expands.

4.1.4 Policy-mix level: Dominican Republic

4.1.4.1 Case description: DR

The EPE launched in early 2021 after being significantly delayed by the COVID-19 lockdown in Rio Ozama, Santo Domingo, Dominican Republic (aka DR policy-mix). This EPE deploys an Interceptor Original (Generation 2) (Figure D.1; Appendix D).

This EPE classifies as a policy-mix-level EPE of the partnership with UNDP, a global developmental organization. UNDP manages this EPE and is The Ocean Cleanup’s primary partner. The Rescate Ozama program encompasses goals beyond the typical objectives of The Ocean Cleanup - so not only dealing with the operation of the Interceptor, but also establishing a multi-stakeholder platform for the comprehensive management of plastics and waste. This collaboration allows for all system dimensions (e.g., market structure, governance, culture, and industry structure) to be targeted (Molas-Gallart et al., 2021). Public entities (e.g., ministries, municipal governments), private actors, developmental actors, and the community are all involved via the Rescate Ozama program. The platform itself consists of a technical committee and a political committee. The primary partner acts as an integrator, assembling said network; promoting the empowerment and collaboration of riverine communities and public-private sectors related to this EPE to prevent waste from reaching the river. The Ocean Cleanup provides the technology and its catalyzing strength, as the Rescate Ozama Program was initiated because of the Interceptor.

The waste management system in the DR EPE is classified as archetype D - distressed and mismanaged, the lowest of all the EPEs selected.

4.1.4.2 Transformative outcomes & transformative social impacts: DR

Five main themes of transformative inputs/activities are identified for the DR EPE. They are presented below in chronological order.

- **Contractual obligations:** The Rescate Ozama programme and its obligations embed TOs into this EPE and represents a transformative input of this river deployment. For example, by involving governments (helping with permits) and *institutionalizing* the programme, the EPE is *shielded* (broadly). Intuitively, *networking* (broadly) is captured by involving a diverse set of actors (e.g., municipalities, developmental actors, public actors and private actors) that undertake joint activities. Additionally, there is an

intermediary actor involved in the platform whose role is to liaise between niche actors and polluting businesses - *strengthening regime-niche interactions*. Dividing the platform into two committees who have regular meeting and working sessions also embeds *navigating expectations* (broadly) within the EPE. The committees include a diversity of actors where different perspectives on topics are discussed.

- **Data and improvements:** There have been several activities within this EPE that focus on improving the status quo. From an operational standpoint, this includes hiring a local operator, implementing incentive schemes, and working to make the Interceptor fully automatic to reduce workload. Such actions *shield* (deeply) the EPE, but also support creating a (deep) *network* by building trust. Much *learning* (broadly) has taken place since the original implementation of the solution, improving the solution based on lived experience. For example, the long barrier redesign, which involved outsourcing some work to other companies and was a common topic in technical committee meetings.
- **Community engagement:** Community engagement is also embedded within the Rescate Ozama programme. Community engagement activities include waste management experiments, and school and nationwide campaigns. The experimentation, led by the primary partner, primarily focuses on understanding the communities along the Rio Ozama and how to best engage with them. These experiments are aimed at *learning* (deeply), *replicating* experiments that have been successful in other areas (rural) in this context (city). One experiment trains community leaders to use motorcycles to collect waste through alleys that are too narrow for municipal waste management trucks. The idea is that the community leaders can *replicate* this knowledge throughout their communities. This experiment also links community leaders to municipalities, *strengthening regime-niche interactions*. Looking towards the social impacts of this activity, improved waste management means there is a positive change to the services provided by the community, and thus, a change in the *local community*. Engaging with community leaders again, the second experiment employs a local grassroots organization to conduct brainstorming sessions with community leaders on solutions to waste problems. *Networking* (deeply) occurs here as this experiment aims to be long-term, something that UNDP remarks as essential for building trust and a sustainable project. Through targeting leaders, trust is also built within the communities themselves as people listen to leaders, thus also *circulating* information that supports the mission. By engaging with community leaders, including them in decision-making or planning exercises, the amount of people involved in

decisions that impact them is increased - positively impacting *local political systems*. Generally, these experiments *upscale* the project by adding community members and organizations to the network. Further, school and national campaigns that promote good waste practices *upscale* the niche. Less directly related to the Rescate Ozama program, but municipalities have also started collecting waste from communities by the riverside. Such engagements activities aimed at citizen education, generate awareness and contribute to changes in the *culture* of local people.

- **Waste management development:** Waste management activities include scoping for the necessary permits, creating sorting center proposals for the government, and adding new stakeholders to the network. Waste management activities are an integral part of ensuring the optimal environment for this EPE, contributing to the *shielding* (deeply) of this project. Deep measures include scoping into the necessary permits, which then feeds the waste management proposals. Waste management solutions also involve adding new stakeholders to the network, *upscale* the EPE. Additionally, The Ocean Cleanup created several sorting center proposals that it presented to the government, to ensure sustainability of the Interceptor project. This activity also demonstrates The Ocean Cleanup's influence on government policy and decisions (*de-aligning and de-stabilizing*). There are several examples of how waste management solutions contribute to *strengthening regime-niche interactions*. For example, to create the proposals the The Ocean Cleanup conducted interviews and studies to understand the waste management space engaging with different government bodies (Ministry of Environment, Presidency) and incumbents (The CocaCola Company). Collaborations between UNDP, the Presidency, the Ministry of the Environment on the sorting and recycling study also draw attention to the visibility of the failing waste management system, *changing perceptions of landscape pressures* by simply strategically positioning the Interceptor.
- **Showcase piece:** The global agreement between UNDP and The Ocean Cleanup generates *circulating, replicating* and *strengthening regime-niche interactions* outcomes. The very notion of this global alliance is to *circulate* ideas and knowledge from the DR EPE to other contents or niches. This is facilitated through meetings between regional UNDP offices and The Ocean Cleanup, for example. This partnership also intends to *replicate* certain aspects of this EPE that are successful locally like the governance arrangements. A quote from the internal project manager summarizes the replicability of this EPE: "But I think it's the model that is interesting. This model of

[a] multi stakeholder platform with the idea of UNDP integrating us, with us providing expertise, technical assistance and treating the legacy problem.” *Regime-niche interactions* are strengthened, as the Interceptor deployment aids in generating discussions between government and the private sector. This interaction is best described using a quote from a UNDP project member:

Research around the river has been going on for decades, but this is the first time that UNDP has managed to sit on the same table for a conversation between institutions of government, people, institutions from civil society who care about the river, and communities.... I mean, everybody sees the problem from a different perspective, but then we have managed to bring everybody to the same table. I think that's very important.

4.1.4.3 Theory of Change: DR

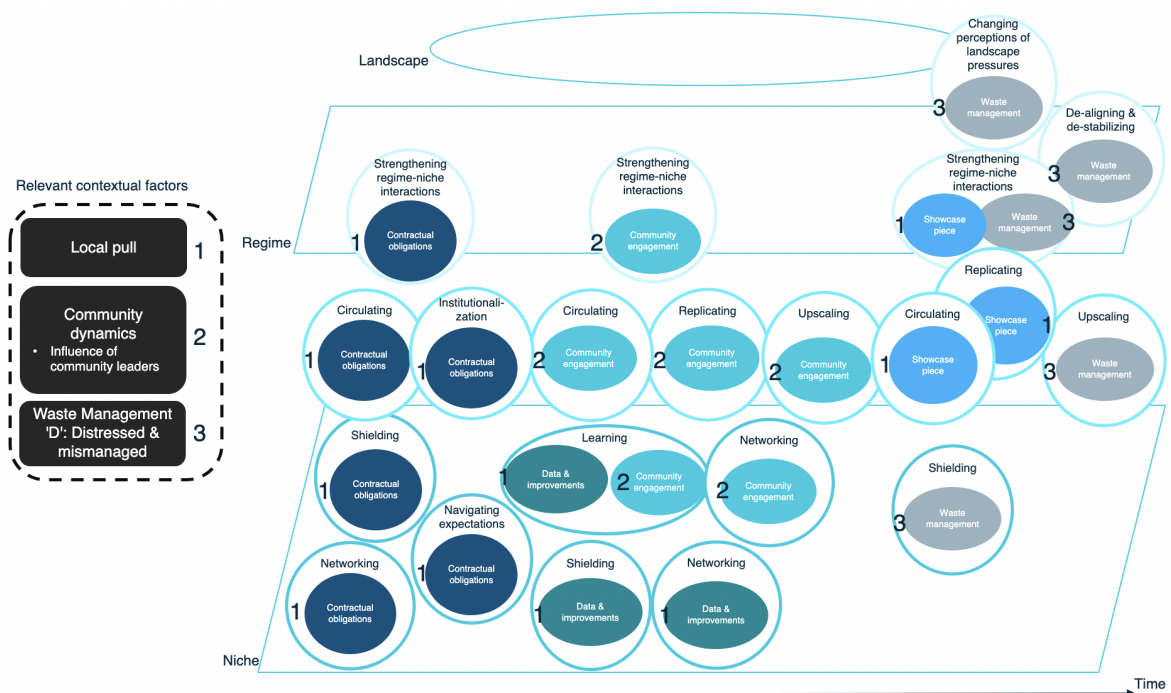


Figure 8: DR’s theory of change as a product. Time is included along the horizontal axis to situate the themes of inputs/activities over time. As it is not explicitly described in text, ‘local pull’ generally refers to the strong support for this EPE, both locally and globally.

Figure 8 showcases how all activity themes, with the exception of ‘Data and improvements’, display TOs at the niche and regime level. Considering the time dimension shown in Figure 8 (moving left to right), it is clear that ‘Contractual obligations’ quickly result in TOs at all levels. It is the only EPE in this study to display the *institutionalization* outcome.

Over time, ‘Data and improvements’ activities become increasingly important at the niche level. Whereas ‘Community engagement’ and ‘Waste management’ activities become especially transformative at the regime level.

Overall, the role of the primary partner is essential to the transformative success of the DR policy-mix as they are instrumental in activities relating to ‘Contractual obligations’ and ‘Community engagement’. The catalyzing power of the Interceptor itself is also quite interesting here - having implication in ‘Showcase piece’ and ‘Waste management’ activities (specifically driving the *changing perceptions of landscape pressures* outcome).

4.2 Cross-case comparison

This section focuses on the cross-case comparison between the EPE results presented in section 4.1 and the generalization of the results to create a general Theory of Change. Results presented in this section come from the EPE sources, and the general sources depicted in Table 1. Table 2 presents the main themes of activities that support each TO per EPE, as described in section 4.1. This table aids in identifying remarkable differences between EPEs.

Here, some initial observations are presented. Looking first at ‘building and nurturing the niche’, each EPE has activities that contribute to each TO. *Navigating expectations* is the least observed TO at this level. Moving to ‘expanding and mainstreaming niches’, *upscaling* and *replicating* TOs display the most activities across EPEs. *Institutionalization* is only observed in the DR policy-mix. The USA project also displays fewer transformative activities at this macro-process level. Lastly, much fewer TOs are observed for the ‘opening up and unlocking regimes’ macro-process. *Strengthening regime-niche interactions* is the most common outcome observed at this level. The DR policy-mix has the most TOs at this level of macro-process.

Table 2: Overview of the transformative outcomes and main categories of activities for each EPE.

TO	Project: USA	Programme: Malaysia	Programme: Jamaica	Policy-mix: DR
Shielding	Community approval; Engaging new stakeholders	Partner alignment	Contractual obligations	Contractual obligations; Data and improvements; Waste management development
Learning	Technology testing; (Environmental) impact monitoring	Monitoring; Community focus; Waste management planning; Solution portfolio development	Iterative approach	Data and improvements; Community engagement
Networking	Community approval	Partner alignment; Monitoring; Solution portfolio development; Waste management planning	Contractual obligations; Iterative approach	Contractual obligations; Data and improvements Community engagement
Navigating expectations	Community approval	Solution portfolio development	Iterative approach	Contractual obligations
Upscaling	Media attention Engaging new stakeholders	Community focus; Waste management planning; Solution portfolio development; Showcase piece	Iterative approach Community outreach	Waste management development; Community engagement
Circulating	Technology testing	Partner alignment	Inspirational ability Community outreach	Community engagement; Showcase piece
Replicating	n/a	Showcase piece	Iterative approach	Community engagement; Showcase piece
Institutionali- zation	n/a	n/a	n/a	Contractual obligations
De-aligning & de-stabilizing	n/a	n/a	n/a	Waste management development

Unlearning & deep learning	n/a	n/a	Inspirational ability	n/a
Strengthening regime-niche interactions	Engaging new stakeholders	Community focus Showcase piece	Community outreach	Community engagement; Waste management development; Showcase piece
Changing perceptions of landscape pressures	n/a	n/a	n/a	Waste management development

4.2.1 Generic, flexible Theory of Change as a product

Figure 10 presents the generic flexible Theory of Change as a product. Flexible, as it is intended to be adapted by The Ocean Cleanup to make its river deployments more transformative, addressing RQ 2. It is important to recall that socio-technical impacts (Figure 10). The following sections present the generalized results pertaining to the transformative outcomes, the key themes of transformative activities, and the key contextual factors.

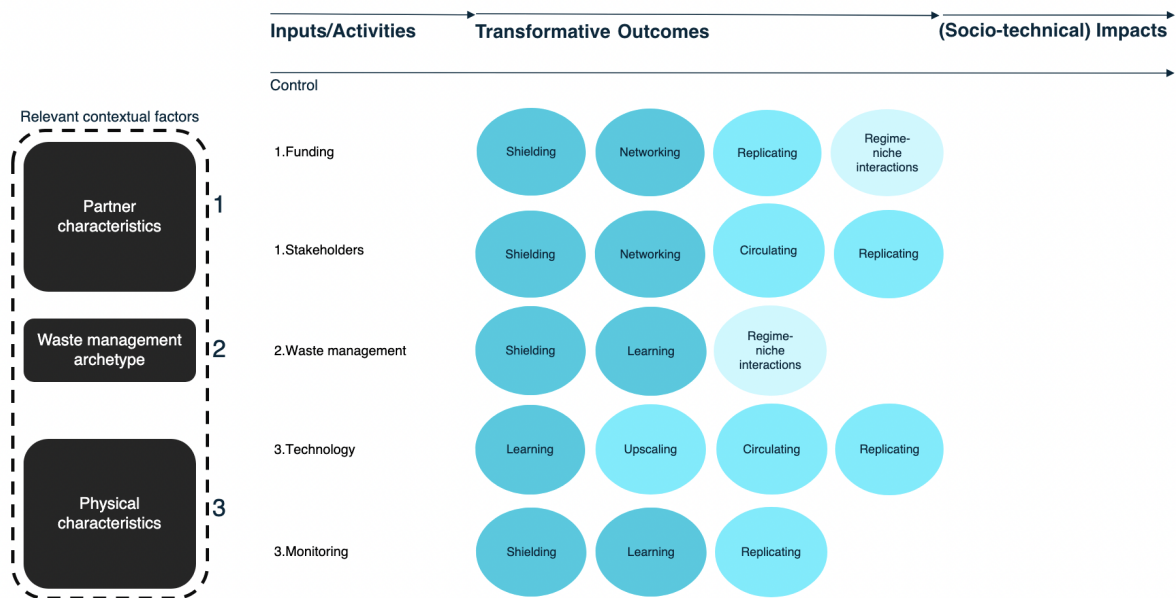


Figure 10: Generic, flexible Theory of Change as a product for The Ocean Cleanup’s River Department. The numbers (1-3) help to connect relevant contextual factors to inputs/activities in which they promote.

4.2.1 Transformative outcomes: Generalized for The Ocean Cleanup

Comparing transformative outcomes across EPEs (Table 2), there are clearly outcomes that are observed more frequently. In terms of ‘building and nurturing the niche’, most of the activities are centered around *shielding* and *learning*. This may be attributed to the validation phase of the River Department, as it is still testing technologies and models of operation. *Networking* is also often present. ‘Expanding and mainstreaming’ outcomes are most often *circulating* and *replicating*. When the case-level results are generalized, there are fewer observed TOs on the ‘opening up and unlocking regimes’ level. *Strengthening regime-niche interactions* is the only outcome present at this level.

4.2.1.2 Key activities underlying transformative outcomes

This subsection discusses the common themes of activities that lead to transformative outcomes across all EPEs. First, these activities are compared and contrasted against each other. Then, they are generalized. The generalized comments are reflected in the themes of activities displayed in Figure 10.

- **Funding:** Funding is an essential part of every EPE. It *shields* the EPE passively and actively, and broadly and deeply. Funding is embedded in the USA project, as the location was strategically selected for that purpose. This motivates the ‘Engaging new stakeholders’ activities (e.g., campaigns). Funding is also an integral part of the Malaysia programme, made a central theme by the partner being profit driven. Most activity themes - ‘Partner alignment’, ‘Waste management planning’, ‘Solution portfolio development’ and ‘Showcase piece’ are all motivated by funding or profit. To illustrate, a member of The Ocean Cleanup on the Malaysia programme explains: “Without the waste from the log booms it will be difficult to fund the operation. If it makes [a] profit, perfect.” Fewer transformative activities within the Jamaica programme and the DR policy-mix are motivated by funding. Although they *shield* the EPEs, they do not drive other TOs like they do in the USA and Malaysia. This may be because of the onus placed on community engagement and outreach activities by the partners within these EPEs. From an organizational level, funding is considered immediately in the scoping approach for future rivers, scanning the business model to ensure the viability or financial longevity of the operation.

On a general level, funding activities are conceptualized as *shielding* (broadly) activities first. Within the River Department, funding is considered immediately in the scoping approach for future rivers by scanning the business model to ensure the

viability or financial longevity of the operation. The Ocean Cleanup is also exploring funding and revenue models that diversify and broaden the typology of sources that fund river deployments, encompassing the *networking* (broadly) and *strengthening regime-niche interactions* outcomes. Such a revenue model, which is now in the test phase, serves as a potential source of *replication*.

- **Stakeholder relationships:** It is clear from the results in Section 4.2 that the partners chosen heavily influence the activities conducted in each EPE. It is the stakeholders that conduct the activities beyond the Interceptor solution itself. For all EPEs this includes the activities that center around the community. In the USA this includes ‘Community approval’, in Malaysia this involves ‘Community focus’ activities, In Jamaica this is ‘Community outreach’, and in DR this is ‘Community engagement’. Although present in every EPE, the TOs observed for each activity theme are not consistent. In the USA, ‘Community approval’ activities are conducted at the beginning of the project and do not extend beyond the niche level. These activities do, however, continue to be important for nurturing the niche. In Malaysia, ‘Community focus’ activities are introduced as the programme is developed and span all three macro-processes. In Jamaica and DR, these activities are embedded in the design of the EPEs, and are really essential at the ‘expanding and mainstreaming niches’ macro-process level.

Finding the best partners and maintaining positive relationships is a task that is important for the overall success and transformational success of the river organization. Managing stakeholders results in *shielding* (broadly) and *networking* (deeply) outcomes in each EPE. This points to the synergies between these two outcomes. The business developer spearheads these activities. It is necessary to ensure partners have a certain level of knowledge to properly execute the EPE and take ownership of the project. This need also prompts *circulating* activities at the organization-level. For example, there will be a service management team launched later this year that will be focused on *circulating* all learnings to partners that operate at the niche level. The independence of The Ocean Cleanup’s partners is essential for *shielding* each river deployment and allowing The Ocean Cleanup to focus resources on scaling. Currently, there is also more emphasis within the organization to attract different partners that focus on mid- and upstream solutions - capturing the *networking* (broadly) outcome. The consortia itself is something the River Organization intends to *replicate*. This means the organization intends to work with the same consortia to deploy multiple

systems - as is the case in Malaysia and Jamaica. By working with the same consortia, The Ocean Cleanup is enabling synergies that shorten the lead time on things like permitting (also *shielding* the EPE).

- **Waste management:** Waste management activities are a part of all the EPEs studied, although to varying degrees of transformity. In the USA project and Jamaica programme, waste management activities are mainly localized and are not particularly transformative to the overall socio-technical environment of the EPE. Again, this is not to say they do not occur, or that they are less important. Whereas, in the Malaysia programme and the DR policy-mix the activities are transformative and extend beyond the niche. The latter is particularly true from the DR policy-mix. Such a finding correlates with DR having the lowest waste management classification, and therefore, requiring more regime-level change.

Generally, there are organization-wide activities to *shield* waste management activities in all river EPEs. A quote from the Business Developer in DR justifies this well:

If [the country doesn't] have a proper waste management, everything goes to the landfill and then when it rains. Everything comes back to the river. We are not solving anything. It's like a circle. So that's why. Waste management is also important to ensure the sustainability and success of the project.

Broadly, there are waste guidelines that have to be adhered to in each river deployment. The EPE's waste manager is constantly looking for more responsible end destinations - a *learning* (deeply) activity. Further, it is understood that waste management activities (e.g., sorting and recycling) have a cost that someone has to bear. A waste manager at The Ocean Cleanup justifies the cost of sustainably sorting waste by stating: "...there's not going to be much revenue from it. But just the social impact that it can generate, I think it outweighs any immediate cost for that". Partnerships are therefore built to offset or minimize that cost (See 'Funding'). The relationship with The Coca Cola Company is an example of this, also representing *strengthening regime-niche interactions*. This partnership is involved with enabling waste management activities in Malaysia and DR.

- **Technology:** Although intrinsic to each EPE, the transformative impact of the technology is variable between EPEs. In the USA ('Technology testing') the technology directly generates TOs. The Malaysia programme ('Solution portfolio development') embeds a lot of TOs, as it sets to expand the programme and the

technologies provided by The Ocean Cleanup. The Jamaica programme uses an ‘Iterative approach’ to apply technological solutions in each gully. In the DR policy-mix, the technology aspect becomes less important - no categories of transformative activities directly address this.

Generally in the validation phase, The Ocean Cleanup is focused on its technological solutions and validating them. This alone constitutes a first-order *learning* on technical, scientific and design aspects. However, through this process the *learning* has become deeper and therefore more transformative. Understanding that the Interceptor is not a one size fits all solution, opens the organization to expanding its repertoire of solutions. The Malaysia and Jamaica programmes are good examples of this. In Malaysia, this was a gradual learning over time (‘Solution portfolio’) and in Jamaica this is a more intentional, case-by-case decision (‘Iterative approach’). This finding has implications for *upscaling*. Simple, low-tech solutions are easier for scaling, however, the Interceptors *upscale* the ideas of The Ocean Cleanup. Technologies and their learnings are *circulated* throughout the organization via internal meetings, workshops and personnel, generally. Technologies are *replicated* across EPEs via three different horizons: existing products that are continuously improved; third party solutions that can be adapted and replicated; and new R&D of non-existent technology that is developed in house when no solutions are available.

- **Monitoring:** Monitoring impact is important to EPEs, specifically contributing to TOs for LA, Malaysia and DR. In Jamaica such activities are less relevant to the transformative success of the EPEs.

Generally, as river EPEs are in a validation phase, monitoring activities are essential. Monitoring templates, like the environmental monitoring template *shield* (deeply) the EPEs. These also ensure the independence of research partners, supporting the scaling of the river deployments by freeing up The Ocean Cleanup’s own resources. Such environmental monitoring has also demonstrated that there are limited negative environmental impacts of the Interceptors, prompting the team to now focus more on monitoring the positive impacts of the systems - a *learning* (deeply) outcome. Monitoring efforts also aim to *replicate* activities. For example, by looking for rivers that are morphologically similar to current rivers.

4.2.1.3 Role of socio-technical context

Figure 10 depicts the general Theory of Change as a product for the River Department. This visual aids in understanding the three main contextual factors that influence the transformative success of the river EPEs, also cementing the importance of place-specificity to the transformative success of The Ocean Cleanup's river EPEs.

- **Physical characteristics:** This contextual element deals with the characteristics of the river itself. Physical characteristics prompt 'Monitoring' and 'Technology' related activities. These activities are most important transformationally (i.e., result in more TOs) in the USA and Malaysia EPEs.
- **Waste management archetype:** The waste management archetype dictates 'Waste management' activities in the EPE. As mentioned above, waste management activities are the most transformative (more, and higher-level transformative outcomes) when the waste management archetype is lower.
- **Partner characteristics:** The characteristics of the partner promote 'Funding' and 'Stakeholder' activities. The actor dimension is quite varied between EPEs and prompts different types of activities. Generally, in Jamaica and DR, where waste management systems are less advanced, community level activities are central and consistent throughout the EPE.

4.2.2 Transformative social impacts

Generally, the River Department is beginning to acknowledge the social impacts of the river EPEs, where it previously did not. As captured in the results section, the technological solution itself does not result in transformation, or in this case, transformative social impacts, but that is not to say they do not occur. One member of the The Ocean Cleanup team states:

The way I see it is our product is impact. That is our ultimate product. The designing of a machine that collects and delivers impact is simply just a tool that we happen to design as well. And I think if we can maximize impact using that tool to drive visibility is the ultimate [goal] really.

Table 4 presents the social impacts that are attributed to transformative activities. Cultural changes are the most common area of social change across EPEs. All of the transformative activities that realize this social impact relate to the community in some way. This is true for the other dimensions of social impacts as well - community-related activities are the most frequently observed. Further the Jamaica and DR EPEs result in the most social

impacts, which embed community outreach or engagement activities into the EPE. Jamaica has the most themes of transformative activities that lead to transformative social impacts.

Table 4: The input/activity themes that lead to transformative social impacts of The Ocean Cleanup’s river deployments. It is important to remember that this is not an exhaustive list of the social impacts scoped for this study; the non-transformative social impacts are excluded.

Social Impact	USA	Malaysia	Jamaica	DR
Changes to the ‘way of life’	Community approval	n/a	n/a	n/a
Changes to the culture	n/a	Community focus	Community outreach	Community engagement
Changes to local community	n/a	n/a	n/a	Community engagement
Changes to political systems	n/a	n/a	n/a	Community engagement
Changes to local environment	Media attention	n/a	n/a	n/a
Changes to financial wellbeing	n/a	Community focus	Contractual obligations; Community outreach	n/a
Changes to the fears and aspirations	n/a	n/a	Inspirational ability	n/a

5.0 Discussion

The results of this study provide many interesting insights into the transformative success of The Ocean Cleanup’s River Department; the transformative impact of place, EPE level, and time on the project; the unique role of The Ocean Cleanup as a non-state mission initiator; and the transformative social impacts resulting from river EPEs. These findings are discussed in more detail below, sometimes bringing in additional not included in the Theory section (Section 2.0) to help explain phenomena. The key insights recorded and numbered in the text; these are reformulated into concrete recommendations for The Ocean Cleanup in the Executive Summary section.

5.1 Strengthening transformative outcomes

Using transformative outcomes to assess the transformative success of The Ocean Cleanup's river mission proves helpful in visualizing the processes needed to enact transitions most effectively. The absence or limited presence of TOs provides clear areas of improvement (Ghosh et al., 2021). Overall, the results pertaining to the transformative outcomes provide a framework for reflexive action (Ghosh et al., 2021), one that The Ocean Cleanup can leverage to improve the transformative success of current and future river deployments. The following section discusses the results related to the transformative outcomes within and across the four EPEs studied. Recommendations based on this, and the generic, flexible Theory of Change for The Ocean Cleanup's River Department (Figure 10) are also discussed. The results are discussed in relation to the current transitions literature.

5.1.1 Nurturing and building niches: Consistently essential

Setting a proper environment for river deployments is a top priority for The Ocean Cleanup. Every EPE exhibits *shielding*, *learning*, *networking* and *navigating expectations* outcomes, with the latter being the least observed. This suggests that when The Ocean Cleanup 'builds and nurtures' a niche, the same outcomes are present (albeit resulting from different activities). Put differently, this implies that EPEs with different place-specific factors and levels (e.g., project, programme, policy-mix) experience the same transformative outcomes. This suggests that transformative outcomes are a suitable theoretical framework to understand the transformative success of EPEs at the niche level. This finding leads to the first insight.

- 1) It is important that *shielding*, *learning*, *networking* and *navigating expectations* are enabled broadly and deeply through EPE activities.

The *navigating expectations* outcome is less common across the EPEs studied. This aligns with theory, as it is challenging to set expectations about the best solutions to the riverine plastic problem. This is especially true as these expectations often change over time (Schot et al., 2019). For example, in Malaysia, it is *learned* that extending the solution portfolio ('Solution portfolio development') will aid the EPE in several ways, the programme is therefore adapted accordingly, taking deliberate measures to *navigate expectations* with local partners. This points to the more **place-based** nature of the *navigating expectations* TO, and the importance of **time** in realizing it. However, it remains important to develop shared visions (Ghosh et al., 2021), especially for The Ocean Cleanup operating in foreign contexts. The results show that The Ocean Cleanup does *navigate expectations* with partners in existing EPEs; however, this outcome is often more reactive (paired with learning or shielding) than

proactive. ‘Contractual obligations’ activities in DR (i.e., committee meetings) are an exception to this statement. This prompts the second recommendation for The Ocean Cleanup:

- 2) To create shared visions and help guide niche development, activities are needed that enable the *navigating expectations* outcome from the onset of the EPE.

As mentioned (briefly) already, the transformative inputs/activities that lead to transformative niche building outcomes do vary per EPE, and are therefore more place-specific. This also aligns with the literature (Ghosh et al., 2021) and is discussed in more detail in Section 5.2.1.

5.1.2 Expanding and mainstreaming niches: Increasingly variable

More variation between results is introduced when mapping TOs that deal with the ‘expanding and mainstreaming niches’ macroprocess. Differences are most obvious when comparing TOs across EPEs of different levels. The USA (project-level) observes the fewest transformative outcomes, and DR (policy-mix) experiences the most. This also makes sense given the multi-scalar nature of transformative outcomes that expand and mainstream the niche. These TOs require connections between local niches and regimes and global ones (Ghosh et al., 2021). This is easier for EPEs, like the DR policy-mix, where there is more specific attention to making a global impact (i.e., via ‘Showcase piece’). The role of EPE levels in transformation is discussed in more detail in Section 5.2.2.

Upscaling activities occur in every EPE, regardless of contextual factors or EPE level. Similarly, to some extent, all EPEs *circulate* ideas, people or technology between niches. However, the extent of circulation seems to correspond with the level of the experiment, with the programme and policy-mix EPEs showcasing *circulating* activities that extend beyond transferring knowledge about the technology. In the DR, for example, the global alliance struck between The Ocean Cleanup and UNDP (i.e., ‘Showcase piece’) facilitates the distribution of collective knowledge at the global level. *Circulating* knowledge globally represents further development towards ‘expanding and mainstreaming niches’ (Geels & Deuten, 2006). In a more general sense, the River Department has more recently recognized the importance of *circulating* knowledge and learnings to local partners in a more formal or uniform way - via the service management team. Again, this spreads global information locally, aligning with the theory and helping to scale niches (Geels & Deuten, 2006). This discussion prompts the third insight:

- 3) To extend the niche, it is necessary to *circulate* knowledge at the global level.

Replicating is also an important outcome across EPEs, although no activities enable this outcome in the USA project. This is likely because the intended goal of the project is not to *replicate* it in other contexts (Section 4.1.2). However, *replication* is a key aim for the rest of The Ocean Cleanup’s river deployments. This transformative outcome is not as simple as making context specific adjustments and involves other TOs like *learning* (Schot et al., 2019). The ‘iterative approach’ in Jamaica showcases how The Ocean Cleanup takes the proper steps to facilitate *replication*, therefore, accelerating niches. Buijs et al. (2019) also highlight the importance of NGOs, like The Ocean Cleanup, in drawing connections between project locations to facilitate momentum for broader socio-technical change.

Institutionalization is the least observed outcome across all EPEs. Schot et al. (2019) suggest that it is difficult to gauge **when** institutionalization efforts should be made. Since all of The Ocean Cleanup’s river deployments are pilots, it makes sense that the solutions be deemed successful before efforts begin to institutionalize them. However, this outcome is necessary for creating sustained change (Schot et al., 2019). Its presence in DR, corresponds with the stronger need to change that socio-technical system (i.e., lowest waste management archetype).

Overall, the results show the increasing variability of transformative outcomes that ‘expand and mainstream’ niches. This prompts the following insights:

- 4) It is important to assess the individual needs of the river deployment’s niche when deciding what ‘expanding and mainstreaming niches’ transformative outcomes to employ, how they should be targeted, and when.
 - a) For example: In areas where the socio-technical system is more uncertain, complex, and disorganized, there is a stronger need to institutionalize the river deployment quickly.

5.1.3 Opening up and unlocking regimes: Indirect outcomes

The Ocean Cleanup’s river deployments have just begun achieving outcomes that ‘open up and unlock regimes’. *Strengthening regime-niche interactions* is the most observed and purposeful outcome in this category. This highlights The Ocean Cleanup’s strong ability in creating connections between niche and regime actors. Section 5.5 describes this strength in more detail.

Changing perceptions of landscape pressures is also present in The Ocean Cleanup’s EPEs (USA, Jamaica, DR). However, this outcome is often enabled indirectly - its presence

being captured via implementing Interceptor solutions (e.g., DR : ‘Waste management’). This suggests that through providing a solution to a problem and drawing visibility to the problem, The Ocean Cleanup facilitates *changing perceptions of landscape pressures*. Similar observations are noted for the *unlearning and deep learning* outcome. Again, this outcome is realized indirectly via Interceptor solutions (e.g., Jamaica: ‘Inspirational ability’). These results suggest that more direct and time-consuming activities to facilitate these TOs, like organizing foresight activities with regime actors (*changing perceptions of landscape pressures*) or planning policy labs with regime actors (*unlearning and deep learning*) (Ghosh et al., 2021), are unnecessary for The Ocean Cleanup. It is worth noting that this observation expands the theoretical understanding of *changing perceptions of landscape pressures*, as an under-explored transformative outcome (Schot et al., 2019; Section 2.3.3.4).

De-aligning and de-stabilizing as an outcome is an integral aspect of shifting regimes - changes to public policy and corporate practices are necessary for successful transformations (Grin, 2010). This TO is most purposefully realized in the DR. *Networking* and *learning* largely contribute to this activity, aligning with theoretical conceptions of generating impact at this level (Naber et al., 2017). This outcome can be challenging to realize because of persisting couplings between regimes that have developed over time (Ghosh et al., 2021; Konrad et al., 2008). For example, the riverine plastic pollution problem is deeply intertwined with the regime’s waste management system and plastic producers. Because of existing path dependencies, these interconnections are challenging to *de-align and de-stabilize* (Ghosh et al., 2023).

Observations of the transformative outcomes associated with ‘opening up and unlocking regimes’ emphasizes the power of The Ocean Cleanup’s Interceptor solutions is achieving outcomes at this level. The following recommendations apply:

- 5) More attention is needed on enabling transformative outcomes that ‘open up and unlock the regime’.
- 6) In this context, it is not necessary to dedicate specific resources towards activities that support *unlearning and deep learning* and *changing perceptions of landscape pressures*.
- 7) Specific attention is needed to facilitate de-aligning and de-stabilizing outcomes.

5.1.4 Synergies between transformative outcomes

This study highlights the synergies between TOs. For example, activities that *shield* the network often also enable *networking* (broadly) by building trust between stakeholders. This is

observed in Malaysia ('Partner alignment'), Jamaica ('Contractual obligations') and DR ('Contractual obligations'). This connection also further highlights the importance of maintaining a happy and connected consortium for the transformative success of The Ocean Cleanup's river EPEs. Another example is how *learning* activities influence *shielding* ones.

Synergies or connections between TOs are not explicitly highlighted in the literature (Ghosh et al., 2021; Molas-Gallart et al., 2021; Schot et al., 2019). In demonstrating these connections, this research extends understanding of transformative outcomes. TOs are dynamic and complementary, especially when applied to missions tackling complex and multifaceted problems like riverine plastic pollution.

5.2 Place, time, level: Influencing the breadth, depth and speed of transformation

As mentioned in the introduction, the role of place, level, and time on the transformative success of The Ocean Cleanup's river deployments is a particularly interesting aspect of this study. The following section discusses these three factors and how they have influenced the transformative success of the river deployments.

5.2.1 Place: Implications for the breadth of transformations

The results point to the importance of place specificity for the relative transformative success of the river deployments. This is most clearly captured when considering the relevant contextual factors outlined in the results - physical characteristics, waste management archetype, and partner characteristics (Section 4.2.1.3). The contextual results primarily help to describe place-based variations to the breadth of transitions observed in each EPE.

River deployments (aka EPEs) are broader if they consider a wider scope of solutions, focusing on mid- and upstream scopes, for example (Andersen et al., 2023). Focusing first on the role of the location's waste management archetype, dedicating activities towards waste management solutions implies broader transformations. This is because it encompasses the institutional dimension of the socio-technical system (See justification in Section 3.2.1). This reaffirms research on transitions that highlights the importance of considering the institutional dimension of the specific location when designing transformative activities, as this leads to different types of transformations (Andersen et al., 2023; Fuenfschilling & Truffer, 2014). For The Ocean Cleanup, the lower the waste management system, the broader the transformative activities are. In other words, there is more emphasis placed on activities that support waste management activities. Participating in waste management activities highlights how actors, like The Ocean Cleanup, can change institutional arrangements while also being constrained by

them, a common theme in the institutional entrepreneurship literature (Jolly et al., 2016). The Ocean Cleanup tries to reshape its institutional environment by engaging with governments to influence waste management activities (i.e., in DR via ‘Waste management’ activities), for example. Conversely, better waste management contexts result in narrower transformations - less emphasis is placed on institutional dimensions. For example, in Malaysia (waste management archetype B) ‘Waste management planning’ activities do not attempt to make any institutional changes and are limited to mainly niche-level outcomes (with the exception of *upscaling*). Overall, these findings correspond with existing literature (Tracey & Phillips, 2011) which suggests that institutional contexts that are working to improve legal and regulatory systems and are attached to a high level of risk and uncertainty (e.g., DR), generate more opportunity for strategic action than more mature economies (e.g., USA or Malaysia) (Child et al., 2007; Jolly et al., 2016). These findings lead to the insights below:

- 8) It is important to consider the institutional context of solution locations in determining the breadth of transformative activities required to achieve a successful transformation.
 - a) A broader set of transformative activities are needed in solution locations where the institutional environment is less established or poorly managed.
 - b) A narrower set of transformative activities are needed in deployment locations where the institutional environment is more established or better managed.

The characteristics of the partner also influence the transformative success of The Ocean Cleanup’s river deployments. This also aligns with the current literature which posits that different types of actors generate different types of transition patterns (Andersen et al., 2023; Geels et al., 2016). In Jamaica and DR, the partners are very community-minded. In Jamaica, the primary partner is a local charitable foundation with lots of experience in the community. In DR, the primary partner is a global developmental organization with lots of experience in facilitating change-making programs at the local level. Due to these actors possessing deep ties to the community, the activities of the EPEs embed the community into the EPE’s design - generating broader transformations by addressing aspects beyond the technology. This prompts the following actor-specific insight:

- 9) It is important to select local partners that address the breadth of the problem in the given socio-technical context.

Not considering the breadth of the transition needed in a specific location can also slow the upscaling of the solution itself (Andersen et al., 2023). For example, not considering sorting and recycling solutions limits the amount of plastic the Interceptor can sustainably catch, thus threatening to slow down adding more Interceptor solutions. For The Ocean Cleanup, this re-

emphasizes the importance of incorporating changes to all systems (upstream and midstream sectors) rather than just focusing on a downstream technical solution.

This section addresses a research gap on how system differences like place-specificity influence transition dynamics (Andersen et al., 2023), suggesting that the institutional and actor context of a location dictates the breadth of transformations needed.

5.2.2 EPE level: Implications for the depth of transitions

Studying river deployments at different levels (project, programme, and policy-mix) also provides a lot of context into the transformational success of the River Department. From a transitions perspective, focusing on only one dimension - technology in this case - is not enough to realize a transition. Institutions and actors also have to change. Involving these dimensions implies a deeper approach (Andersen et al., 2023).

The level of EPE directly relates to the depth of the transition. Individual projects, like the USA project, are shallower as they primarily focus on the technological dimension or technological goal of the project. This is further reflected when examining the transformative outcomes of this project, which are the fewest and mostly realized at the niche level.

Programmes, like Malaysia and Jamaica, have deeper transformations. This is clear by the greater number of transformative outcomes observed in the higher-level macro-processes, especially at the ‘expanding and mainstreaming niches’ level. Molas-Gallart et al (2021) corroborate this observation, as the very intention of programmes is to scale niche experiments. Expanding on this line of transitions thinking, programmes extend technological change by adding more technological solutions. They also start to address the actor dimension of change. Reorienting actors involves changes to their routines, capabilities, values, and worldviews (Andersen et al., 2023). This is exemplified by the community-centered educational and awareness activities happening in Malaysia and Jamaica. These two programme-level EPEs do not, however, exhibit the same transformation processes. This is likely attributed to place-specific and time factors. However, both programmes showcase The Ocean Cleanup’s progress towards scaling its river deployments.

Policy-mixes, like DR, incorporate institutional change (or the ambition to do so) as well as changes to technology and actors, resulting in the deepest transformations of the EPEs studied. The DR policy-mix showcases the most transformative outcomes, exhibiting a range of transformative activities at every level (with the exception of *unlearning and deep learning*). This also aligns with what Molas-Gallart et al. (2021) say about policy-mixes; this level of EPE is intended to realize socio-technical system change.

Overall, the river deployments yielded results according to their EPE level that are consistent with the theory (Molas-Gallart et al., 2021). This suggests the suitability of using a nested approach to assess multi-level TIPs or missions. Future research may focus on using this approach to study multiple experiments enacting the same TIP at the policy-mix level, rather than just one. This is prompted by the variation in results in studying two programme-level EPEs. Studying multiple policy-mix EPEs may provide more nuanced insight into realizing socio-technical systems change. The following insights are generated:

- 10) Developing programme-level EPEs is important for expanding and mainstreaming niches.
- 11) Policy-mix-level EPEs derive the deepest transformations - igniting changes to all dimensions of the socio-technical system (technology, actors, institutions).

5.2.3 Time: Implications to the speed of transformations

The results showcase the role of time within the organization. First, looking at individual river deployments, time creates broader and deeper transformations. In Malaysia, for example, the importance of community is recognized as a key component over time and more community focused activities are added to the programme. Or in DR, time and experience emphasized the importance of waste management solutions. Overall, time allows for the aspects of the system beyond the Interceptor to be addressed. Relating this to the concept of speed in transitions (Andersen et al., 2023), the results suggest that broader and deeper transformations may slow the overall process; however, they are essential in EPEs where broad and deep change is needed.

By understanding that broad and deep transitions are necessary in some locations and take longer to realize, The Ocean Cleanup can employ acceleration activities to speed the rate of transformation. This is relevant for The Ocean Cleanup as it aims to tackle the 1000 most polluting rivers by 2040. There are different acceleration mechanisms identified in the transitions literature (Andersen et al., 2023). These mechanisms deal with the technical dimension (e.g., performance improvements of The Ocean Cleanup's Interceptors resulting from learning processes), the actor dimension (e.g., forming actor networks around Interceptor solutions), and the institutional dimension (e.g., policy changes that support plastic pollution prevention). This leads to the following insight:

- 12) Acceleration activities can be used to speed up broad and deep transformations.

5.3 Role of non-state mission initiator

This study also considers the role of The Ocean Cleanup, a non-state actor in pursuing a societal mission - an area of literature that is underexplored (Janssen et al., 2021; Klerkx & Begemann, 2020; Mazzucato, 2018). Most of the mission literature focuses on the role of state actors in initiating missions. However, for The Ocean Cleanup's river deployments, they are typically the mission initiator, with the exception of the Malaysia programme.

This study demonstrates the influential role of The Ocean Cleanup, a non-state nonprofit organization, in the transformation process. Transitions literature on the role of nonprofit organizations in the transformation process typically limits impact to the local level, rarely reaching the regime level (Aiken, 2017; Buijs et al., 2019). This is because scaling local experiments toward a broader socio-technical transformation is challenging, complex, and uncertain (Buijs et al., 2023). The DR EPE contradicts this research, generating impacts at the regime level. This, however, would not be possible without regime-level actors (e.g., via the Rescate Ozama programme). Such reliance on alliances and partnerships for the transformative success of the river deployments is consistent with the transitions literature, as transformations typically result from the interactions between a diverse set of actors (Buijs et al., 2019; Grin, 2010). It also aligns with the transformative outcomes. As partnerships with other actors are captured by at least one outcome at every level. Most interestingly, *strengthening regime-niche* interactions is the most common 'opening up and unlocking regimes' outcome across The Ocean Cleanup's river deployments. This further showcases the unique role The Ocean Cleanup plays in assembling and mobilizing a diverse set of actors, from niches and regimes, around a common goal. Based on these results, the following insights are derived:

- 13) Diverse actor networks are essential in enacting socio-technical transformations as a non-state actor.

5.4 Transformative social impacts

The results showcase how community-centered activities lead to the most transformative social impacts. This reaffirms the importance of activities that address community needs if social impacts wish to be leveraged in current and future river deployments.

Additionally, cultural social change is the most commonly observed social impact across The Ocean Cleanup's river deployments. Enacting cultural change, specifically changing values and mind-sets, is considered the most challenging yet influential factor for increasing the impact of sustainability transitions (Lam et al., 2020; Richardson et al., 2020).

Bennett et al. (2016) emphasize the role of fostering this change locally through hands-on practices. The beach cleanups in the Jamaica programme are a good example of this.

In all river deployments, the transformative impacts were most often a result of The Ocean Cleanup's partners' activities. Again, this reaffirms the importance of partnerships to the River Department.

When considering the transformative social impacts of the river deployments and how they help contribute to the overarching socio-technical change, it is important to remember that these changes are localized social changes and not more global, trans. However, as with the conceptual understandings of EPEs (Schot et al., 2019), these social impacts can expand and compound to create more far-reaching societal impacts.

This discussion prompts to following insights:

- 14) Community-centered activities are essential in leveraging social impacts.
- 15) Cultural change is the most challenging social impact to modify, yet it is also the most observed. EPE activities that enable this impact, should be amplified.

5.7 Limitations

There are several limitations of this research that must be considered. Firstly, the amount of data collected per EPE was not always equal. No local-level interview data was collected for the USA project. Internal interviews and gray literature (internal) are used to supplement the lack of external data. Further, more interviews were conducted for the Malaysia EPE, both internally and externally. This must be considered when looking at the results. It is probable that the more data compiled, the more likely it is to find examples of transformative outcomes or social impacts. Therefore, it is important to remember that the results should not be thought of as exhaustive or complete for any of the EPEs.

Returning to the third guiding principle of the formative evaluation process (Section 3.1.1), the evaluation should be inclusive and participatory (Molas-Gallart et al., 2021). External interviews partially covered this principle (excluding the USA project). However, local voices not directly affiliated with the project were not included, possibly disregarding power imbalances (Molas-Gallart et al., 2021). Additionally, only consulting partners directly involved with The Ocean Cleanup may lead to biases in terms of the transformative success of the river deployments.

The Theories of Change also present limitations to this research. Firstly, they represent the transformation environment at a moment in time. They need to be revisited and readapted regularly to hold up (Hivos, 2015). Additionally, because a Theory of Change is built on

assumptions, they should be considered with caution (Hivos, 2015). Although there were efforts to validate such assumptions (Section 3.4), there is still room for error.

Lastly, it is important to be cautious when extrapolating the results from the four EPEs to draw insights into all current and potential river deployment locations. Although this study does make these assumptions, it is important to remember that the EPEs studied do not reflect all possible socio-technical contexts. Increasingly, the results point to the importance of examining the unique characteristics of each river deployment and adapting the activities accordingly. As such, it is recommended that The Ocean Cleanup continue to study and monitor the transformative success and social impacts of its river deployments to continue adding to this repertoire of knowledge.

7.0 Conclusion

The Ocean Cleanup started its journey tackling plastic pollution in rivers with a fixed mission and a fixed approach - use technological solutions. Through experimentation, its approach has changed significantly based on the needs of each river deployment location, now involving other dimensions of the socio-technical system, such as different types of actors or considering other facets of the riverine plastic problem. Evaluating the transformative outcomes (TOs) of The Ocean Cleanup's river deployments provides valuable insights into the activities needed for effective transitions. The analysis of TOs within and across the studied Experimental Policy Engagements (EPEs) highlights areas for improvement and offers recommendations for enhancing transformative outcomes.

Through the four EPE subcases chosen, the relevance of place-specificity, EPE level, and time to the transformational success of The Ocean Cleanup's river deployments is made clear. The Ocean Cleanup's ability to adapt its approach to the specific socio-technical contexts of each EPE is crucial. Considering such factors enhances the breadth and overall success of future river deployments. The EPE level influences the depth of transformation: intuitively finding that higher-level EPEs (i.e., policy-mixes) result in the most significant transformational changes. The results also demonstrate how The Ocean Cleanup has become more transformative over time, undertaking activities that constitute broader and deeper transformations. Such a learning can now be extended to speed up the rate of transformation. This will prove essential as the 2040 target to tackle plastic pollution in the 1000 most polluted rivers in the world approaches.

Additionally, by assessing the transformative success of The Ocean Cleanup's river deployments, this study challenges the notion that non-state actors are limited to local-level impacts. The success of the river deployments relies on alliances and partnerships, emphasizing the importance of diverse actors in driving transformative change.

This study also provides a first step towards scoping the transformative social impacts of the river deployments. Cultural impacts and community-centered activities are areas that require more attention from The Ocean Cleanup. These are increasingly important to understand as the organization continues to explore its beneficial impacts beyond plastic extraction.

Although The Ocean Cleanup has evolved its approach over ten years, its ambitious nature remains. This study demonstrates that the organization can enact and influence change beyond its technologically driven intentions. Whether it is through transformative outcomes that span beyond localized niche efforts and make regime-level impact or through community-driven impact that drive tangible changes to local communities, The Ocean Cleanup and its Interceptor solutions are conduits for meaningful, transformative change. Leveraging these positive outcomes and impacts will prove useful as The Ocean Cleanup continues to scale its river deployments. Further, harnessing and enhancing this transformational power will help it achieve its overarching goal of ridding the world's oceans of plastic and ultimately becoming obsolete.

References

- Aiken, G. T. (2017). The politics of community: Togetherness, transition and post-politics. *Environment and Planning A*, 49(10). <https://doi.org/10.1177/0308518X17724443>
- Andersen, A. D., Markard, J., Bauknecht, D., & Korpås, M. (2023). Architectural change in accelerating transitions: Actor preferences, system architectures, and flexibility technologies in the German energy transition. *Energy Research and Social Science*, 97. <https://doi.org/10.1016/j.erss.2023.102945>
- Bennett, E. M., Solan, M., Biggs, R., McPhearson, T., Norström, A. V., Olsson, P., Pereira, L., Peterson, G. D., Raudsepp-Hearne, C., Biermann, F., Carpenter, S. R., Ellis, E. C., Hichert, T., Galaz, V., Lahsen, M., Milkoreit, M., Martín López, B., Nicholas, K. A., Preiser, R., ... Xu, J. (2016). Bright spots: seeds of a good Anthropocene. *Frontiers in Ecology and the Environment*, 14(8). <https://doi.org/10.1002/fee.1309>
- Boon, W., & Edler, J. (2018). Demand, challenges, and innovation. Making sense of new trends in innovation policy. *Science and Public Policy*, 45(4). <https://doi.org/10.1093/SCIPOL/SCY014>
- Borrelle, S. B., Ringma, J., Lavender Law, K., Monnahan, C. C., Lebreton, L., McGivern, A., Murphy, E., Jambeck, J., Leonard, G. H., Hilleary, M. A., Eriksen, M., Possingham, H. P., De Frond, H., Gerber, L. R., Polidoro, B., Tahir, A., Bernard, M., Mallos, N., Barnes, M., & Rochman, C. M. (2020). Predicted growth in plastic waste exceeds efforts to mitigate plastic pollution. *Science*, 369(6509). <https://doi.org/10.1126/SCIENCE.ABA3656>
- Bours, S. A. M. J. V., Wanzenböck, I., & Frenken, K. (2022). Small wins for grand challenges. A bottom-up governance approach to regional innovation policy. *European Planning Studies*, 30(11). <https://doi.org/10.1080/09654313.2021.1980502>
- Buijs, A., Hansen, R., Van der Jagt, S., Ambrose-Oji, B., Elands, B., Lorance Rall, E., Mattijssen, T., Pauleit, S., Runhaar, H., Stahl Olafsson, A., & Steen Møller, M. (2019). Mosaic governance for urban green infrastructure: Upscaling active citizenship from a local government perspective. *Urban Forestry and Urban Greening*, 40. <https://doi.org/10.1016/j.ufug.2018.06.011>
- Chi, C. F., Pan, J. S., Liu, T. H., & Jang, Y. (2004). The development of a hierarchical coding scheme and database of job accommodation for disabled workers. *International Journal of Industrial Ergonomics*, 33(5). <https://doi.org/10.1016/j.ergon.2003.11.003>
- Child, J., Lu, Y., & Tsai, T. (2007). Institutional entrepreneurship in building an environmental protection system for the people's Republic of China. *Organization Studies*, 28(7). <https://doi.org/10.1177/0170840607078112>
- Dubois, A., & Gadde, L. E. (2002). Systematic combining: An abductive approach to case research. *Journal of Business Research*, 55(7). [https://doi.org/10.1016/S0148-2963\(00\)00195-8](https://doi.org/10.1016/S0148-2963(00)00195-8)
- Elzinga, R., Janssen, M., Wesseling, J., Negro, S., & Hekkert, M. (2023). *Assessing mission-oriented innovation systems: Towards an analytical framework*. Utrecht.
- Fuenfschilling, L., & Truffer, B. (2014). The structuration of socio-technical regimes - Conceptual foundations from institutional theory. *Research Policy*, 43(4). <https://doi.org/10.1016/j.respol.2013.10.010>
- Geels, F. W., Kern, F., Fuchs, G., Hinderer, N., Kungl, G., Mylan, J., Neukirch, M., & Wassermann, S. (2016). The enactment of socio-technical transition pathways: A reformulated typology and a comparative multi-level analysis of the German and UK low-carbon electricity transitions (1990–2014). *Research Policy*, 45(4), 896–913. <https://doi.org/10.1016/j.respol.2016.01.015>
- Geels, F., & Deuten, J. J. (2006). Local and global dynamics in technological development: A socio-cognitive perspective on knowledge flows and lessons from reinforced concrete. *Science and Public Policy*, 33(4). <https://doi.org/10.3152/147154306781778984>

- Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. *Research Policy*, 31(8–9). [https://doi.org/10.1016/S0048-7333\(02\)00062-8](https://doi.org/10.1016/S0048-7333(02)00062-8)
- Ghosh, B., Kivimaa, P., Ramirez, M., Schot, J., & Torrens, J. (2021). Transformative outcomes: Assessing and reorienting experimentation with transformative innovation policy. *Science and Public Policy*, 48(5). <https://doi.org/10.1093/scipol/scab045>
- Grin, J. (2010). Understanding Transitions from a Governance Perspective. In *Transitions to Sustainable Development: New Directions in the Study of Long Term Transformative Change*.
- Haddad, C. R., & Bergek, A. (2023). Towards an integrated framework for evaluating transformative innovation policy. *Research Policy*, 52(2). <https://doi.org/10.1016/j.respol.2022.104676>
- Hivos. (2015). Theory of Change Thinking in practice - a stepwise approach. *Hivos*.
- Janssen, M. J., Bergek, A., & Wesseling, J. H. (2022). Evaluating systemic innovation and transition programmes: Towards a culture of learning. *PLOS Sustainability and Transformation*, 1(3). <https://doi.org/10.1371/journal.pstr.0000008>
- Janssen, M. J., Torrens, J., Wesseling, J. H., & Wanzenböck, I. (2021). The promises and premises of mission-oriented innovation policy - A reflection and ways forward. *Science and Public Policy*, 48(3). <https://doi.org/10.1093/scipol/scaa072>
- Jolly, S., Spodniak, P., & Raven, R. P. J. M. (2016). Institutional entrepreneurship in transforming energy systems towards sustainability: Wind energy in Finland and India. *Energy Research and Social Science*, 17. <https://doi.org/10.1016/j.erss.2016.04.002>
- Klerkx, L., & Begemann, S. (2020). Supporting food systems transformation: The what, why, who, where and how of mission-oriented agricultural innovation systems. *Agricultural Systems*, 184. <https://doi.org/10.1016/j.agry.2020.102901>
- Konrad, K., Truffer, B., & Voß, J. P. (2008). Multi-regime dynamics in the analysis of sectoral transformation potentials: evidence from German utility sectors. *Journal of Cleaner Production*, 16(11). <https://doi.org/10.1016/j.jclepro.2007.08.014>
- Lam, D. P. M., Martín-López, B., Wiek, A., Bennett, E. M., Frantzeskaki, N., Horcea-Milcu, A. I., & Lang, D. J. (2020). Scaling the impact of sustainability initiatives: a typology of amplification processes. *Urban Transformations*, 2(1). <https://doi.org/10.1186/s42854-020-00007-9>
- Mazzucato, M. (2018). Mission-oriented innovation policies: Challenges and opportunities. *Industrial and Corporate Change*, 27(5). <https://doi.org/10.1093/icc/dty034>
- Molas-Gallart, J., Boni, A., Giachi, S., & Schot, J. (2021). A formative approach to the evaluation of Transformative Innovation Policies. *Research Evaluation*, 30(4). <https://doi.org/10.1093/reseval/rvab016>
- Naber, R., Raven, R., Kouw, M., & Dassen, T. (2017). Scaling up sustainable energy innovations. *Energy Policy*, 110. <https://doi.org/10.1016/j.enpol.2017.07.056>
- Richardson, M., Dobson, J., Abson, D. J., Lumber, R., Hunt, A., Young, R., & Moorhouse, B. (2020). Applying the pathways to nature connectedness at a societal scale: a leverage points perspective. *Ecosystems and People*, 16(1). <https://doi.org/10.1080/26395916.2020.1844296>
- Rolfe, S. (2019). Combining Theories of Change and Realist Evaluation in practice: Lessons from a research on evaluation study. *Evaluation*, 25(3). <https://doi.org/10.1177/1356389019835229>
- Schot, J., Kivimaa, P., & Torrens, J. (2019). *Transforming Experimentation: Experimental Policy Engagements and Their Transformative Outcomes*. Transformative Innovation Policy Consortium.
- Schot, J., & Steinmueller, W. E. (2018). Three frames for innovation policy: R&D, systems of innovation and transformative change. *Research Policy*, 47(9). <https://doi.org/10.1016/j.respol.2018.08.011>

- Smith, A., & Raven, R. (2012). What is protective space? Reconsidering niches in transitions to sustainability. *Research Policy*, 41(6). <https://doi.org/10.1016/j.respol.2011.12.012>
- Termeer, C. J. A. M., & Dewulf, A. (2019). A small wins framework to overcome the evaluation paradox of governing wicked problems. *Policy and Society*, 38(2). <https://doi.org/10.1080/14494035.2018.1497933>
- The Ocean Cleanup. (2023a). *About : The Impact of Cleanup*. Retrieved February 1, 2023, from <https://theoceancleanup.com/about/>
- The Ocean Cleanup. (2023b). *Rivers*. Retrieved February 1, 2023, from <https://theoceancleanup.com/rivers/>
- Thyer, B. A. (2019). The Handbook of Social Work Research Methods. In *The Handbook of Social Work Research Methods*. <https://doi.org/10.4135/9781544364902>
- Torrens, J., Johnstone, P., & Schot, J. (2018). Unpacking the formation of favourable environments for urban experimentation: The case of the bristol energy scene. *Sustainability (Switzerland)*, 10(3). <https://doi.org/10.3390/su10030879>
- Tracey, P., & Phillips, N. (2011). Entrepreneurship in emerging markets strategies for new venture creation in uncertain institutional contexts. *Management International Review*, 51(1). <https://doi.org/10.1007/s11575-010-0066-8>
- Turnheim, B., Berkhout, F., Geels, F., Hof, A., McMeekin, A., Nykvist, B., & van Vuuren, D. (2015). Evaluating sustainability transitions pathways: Bridging analytical approaches to address governance challenges. *Global Environmental Change*, 35. <https://doi.org/10.1016/j.gloenvcha.2015.08.010>
- United Nations. (n.d.). Nations agree to end plastic pollution. United Nations. <https://www.un.org/en/climatechange/nations-agree-end-plastic-pollution>
- Vanclay, F. (2003). International principles for social impact assessment. *Impact Assessment and Project Appraisal*, 21(1). <https://doi.org/10.3152/147154603781766491>
- Vince, J., & Hardesty, B. D. (2017). Plastic pollution challenges in marine and coastal environments: from local to global governance. *Restoration Ecology*, 25(1). <https://doi.org/10.1111/rec.12388>
- Weber, K. M., & Rohracher, H. (2012). Legitimizing research, technology and innovation policies for transformative change: Combining insights from innovation systems and multi-level perspective in a comprehensive “failures” framework. *Research Policy*, 41(6). <https://doi.org/10.1016/j.respol.2011.10.015>
- Wilson-Grau, R., & Britt, H. (2012). Outcome harvesting. *Ford Foundation*, 2012(May).

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Appendices

Appendix A: Interview Guide Template

General

1. Is it okay if I record this conversation, for analysis purposes later?
2. Can you please describe your role at The Ocean Cleanup and on the _____ project?
3. How long have you been a part of the _____ project?

Building and Nurturing Niches

First, I am interested in the shielding or protective mechanisms present in the _____ project.

4. [SHIELDING (passive)]: This may resemble ensuring certain pre-conditions before embarking on a project - like local entities that provide regulatory, financial or public support for a project, geographical preconditions, etc. Can you think of any examples of this in the project?
5. [SHIELDING (active)]: Shielding may also resemble more actively implementing protective measures to ensure that the project has the optimal conditions to enact the goal of river clean up. Again this encompasses regulatory, financial, and societal measures. Are there examples of shielding or protective mechanisms that were more actively implemented to ensure the optimal conditions for river clean up? [EXAMPLE: To give a more concrete example, this can include investment in existing waste management infrastructure in the niche to ensure plastics do not return to the river after extraction.]
 - a. Why were / are these protective measures pursued?
 - b. How were they put into place?
6. [SHIELDING]: [If applicable] Do you expect these measures to be sustained throughout the duration of the project? In other words, will they still be in place after The Ocean Cleanup scales back their involvement? (Ghosh et al., 2021)
7. [LEARNING]: Do you continuously learn, reflect and adapt the _____ project?
 - a. If yes, how?
8. [LEARNING]: Is learning generated around technical, scientific and design aspects?
 - a. How is this learning carried out?
9. [LEARNING]: Is learning generated around markets and user preferences?
 - a. How is this learning carried out?
10. [LEARNING]: Is learning generated around cultural and symbolic meanings?
 - a. How is this learning carried out?
11. [LEARNING]: Is learning generated around regulations and government policy?
 - a. How is this learning carried out?
12. [LEARNING]: Are some learnings more influential or relevant than others?
 - a. Why is this the case?
13. [NETWORKING]: Do you feel as though the actors involved in the project represent the needs of the project target group?

14. [NETWORKING]: Are more marginal voices taken into account?
 - a. If so, how?
15. [NETWORKING]: Is there a process or effort to distribute the costs and benefits of the project between different stakeholders?
 - a. Can you talk about this process a little bit?
16. [NETWORKING]: Are there any challenges with working with different stakeholders?
 - a. If so, how are they dealt with?
17. [NETWORKING]: In any phase of the project, are there efforts to find and mobilize new kinds of actors?
 - a. How is this done? Who does this? What is the purpose?
18. [EXPECTATION DYNAMICS]: What are the expectations of the project?
 - a. How were these expectations developed? What stakeholders were involved in this process?
19. [EXPECTATION DYNAMICS]: Are the expectations of the project shared across stakeholders?
 - a. If not, how are differences accounted for and addressed?
20. [EXPECTATION DYNAMICS]: Have expectations changed throughout the project?

Expanding and upscaling niches

21. [UPSCALING] : Is there a strategy to upscale the project? What is it?
22. [UPSCALING]: Are there barriers and opportunities to upscaling this project? What are they?
23. [UPSCALING]: Since the implementation of this project, do you think there has been a larger uptake of the goal of cleaning up the ____ river? For example, independent clean up efforts (Ghosh et al., 2021).
 - a. [EXPECTATION DYNAMICS]: Does The Ocean Cleanup support/participate/interact with these efforts in any way?
24. [REPLICATION]: Does this project offer learnings that have or can be replicated in other projects?
 - a. If so, how?
25. [CIRCULATION]: Are ideas and resources within the project circulated between different teams, partners, etc?
 - a. How is this circulation happening? Are there challenges with this/ can it be improved?
26. [CIRCULATION]: Does this circulation of learning happen from the local level to the global one? (Ghosh et al., 2021)
 - a. If so, how?

27. [INSTITUTIONALISATION]: Are rules and norms that support clean rivers becoming more widely implemented and accepted in the ___ region?
- a. If so, how? Who is involved in this?

Opening up and unlocking regimes

28. [DESTABILIZATION ; UNLEARNING & DEEP LEARNING]: Does the project dismantle any old, harmful practices or laws?
- a. If so, how? Are there formal structures or activities that facilitate this?
 - b. [DESTABILIZATION ; UNLEARNING & DEEP LEARNING]: In this dismantling, are alternative practices or laws offered? If so, how?
29. [STRENGTHENING REGIME-NICE INTERACTIONS]: Are there partnerships between existing actors (i.e., governments, incumbent firms, etc) and newer actors specifically focused on river cleanup?
- a. If so, who are these partnerships between? How does it help the process of river cleanup?
30. [CHANGING PERCEPTIONS OF LANDSCAPE PRESSURES]: Do you think the more local stakeholders have a good understanding of their riverine plastic problem? Do you think this understanding has changed throughout the project (involvement of The Ocean Cleanup)?

(Social) Impacts

31. Does this project result in a change to the way of life of local people? Way of life involves how they live, work, play, interact on a day-to-day basis]
- a. Are there specific processes/activities/ aspects of the project that resulted in this change?
32. Does this project result in a change in the culture of local people? Culture encompasses shared beliefs, customs, values, and language, etc.
- a. Are there specific processes/activities/ aspects of the project that resulted in this change?
33. Does this project result in a change in local communities? Change in community means its cohesion, stability, character, services and facilities.
- a. Are there specific processes/activities/ aspects of the project that resulted in this change?
34. Does this project result in a change in the local political systems? Changes in the political systems involve the extent to which people are able to participate in decisions that affect their lives, the level of democratization that is taking place, and the resources provided for this purpose].
- a. Are there specific processes/activities/ aspects of the project that resulted in this change?
35. Does this project result in a change in the local environment? Examples of changes to the local environment include changes to the quality of air and water people use; the availability and quality of the food they eat; the level of exposure to hazard or risk; their physical safety; their access to resources, etc.

- a. Are there specific processes/activities/ aspects of the project that resulted in this change?
36. Does this project result in a change in the health and wellbeing of local people? Health and wellbeing encompasses the physical, mental, social and spiritual wellbeing.
- a. Are there specific processes/activities/ aspects of the project that resulted in this change?
37. Does this project result in a change in the personal and property rights of local people? Personal and property rights encompass whether people are economically affected by this project.
- a. Are there specific processes/activities/ aspects of the project that resulted in this change?
38. Does this project result in a change in the fears and aspirations of local people? Fears and aspirations involve their perceptions about their safety, the future of their community and family, etc.
- a. Are there specific processes/activities/ aspects of the project that resulted in this change?

Other

39. Is there anything you want to add after hearing all of the interview questions?

Appendix B: Transformative Outcomes Analysis Sheet.

Table B: Transformative outcomes analysis sheet. This table was derived from Schot et al (2019) and Ghosh et al (2021).

Macro-process	TO	Description	Examples
Building and Nurturing Niches	Shielding	Passive: pre-existing supportive mechanisms Active: deliberate mechanisms for optimal environment Broadening: active & passive at the same time Deepening: when active measures become passive	Certifications (P); Funding initiatives (B); Subsidies for innovation projects (B); Media campaigns to promote the solution (B) Permanent exemptions (D)
	Learning	1st: improving what actors are doing 2nd: questions frames & assumptions of structures & activities Broad: multiple dimensions of system in 1st & 2nd, multiple actors Deep: creating opportunities for challenging assumptions (about preferred solutions, problem definition, etc)	Not just on dev tech but how to make bus models sustainable (B); Workshop with a diversity of actors about whether EVs are only for rich people (D); experimenting/ searching for solutions individually & collectively (D)
	Networking	High-quality opportunities for collaboration between actors, strengthening networks. Broad: joint activities where multiple actors gather & mobilize. Diverse beliefs, values, & concerns are recognized Deep: enhancing mobilizing power, trust, & coordination among the actors involved in niches. Ensuring the stability of actor-networks over time	Cooperatives include a diversity of actors (patients, food, fitness) next to health care prof., policy makers, etc., to test new ways of local health care provision that integrate healthcare with lifestyle; Establish intermediary niche actors that build platforms for more permanent interaction between various actors (D)

	Navigating Expectations	Create spaces for articulating expectations around societal challenges & appraising these expectations to enhance their credibility, quality, & stability Broad: allowing diversity of actors to voice their expectations around landscape challenges, the regime's ability to respond, & promise of niches to provide solutions. Tensions & conflicts of interest among expectations are accepted & clear Deep: developing credible expectations by aligning landscape, regime, & niche EPEs of niche & regime actors & supporting this alignment with concrete evidence	Futuring processes that discuss diff expectations about the future of water management in a specific region addressing conflicting demands of actors & allowing for deliberations (B); Organizing a transition arena where actors have to create a shared vision & proposals for a set of experiments for new water management practices they will collectively develop & fund (D)
Expanding and Mainstreaming Niches	Upscaling	Increased adoption by users of the new emerging system. Includes adoption of policy measures, industry strategies, cultural meanings & symbols	Addition of new stakeholders; Communication & marketing campaigns
	Circulating	Identifying & promoting the circulation of ideas, people, blueprints, & technology between niches on a continuous basis	Changing jobs between organizations; Intermediary actor responsible for circulation among a range of EPEs via training to exchange ideas, mutual visits, promotion activities
	Replication	Intentionally facilitating the replication of specific niche experiments in other contexts	Creating a mechanism (funding, intermediary actor, education, capacity-building program) for replicating an experiment with local and direct food provisions from one to many cities
	Institutionalization	Mainstreaming the rules of the niche (behavior, beliefs, & vals) among existing and new niche actors	Handbook; certification scheme
Opening up and unlocking regimes	De-aligning and de-stabilizing	Facilitating dev of disruptive policy frameworks & governance arrangements that challenging existing systems	Protests, pressure on government; Developing a phase out policy for coal burning plants; Going to court to challenge non-compliance with internationally agreed targets on reducing CO2 emissions
	Unlearning and deep learning	Facilitating unlearning & deep learning of regime actors, helping to reassess the regime rules, comparing alternate rules for solving systemic problems	Organizing a policy lab discussing a variety of policy barriers for using insects as a food product in The Netherlands
	Strengthening regime-niche interactions	Creating linkages between niche & regime actors, their ideas & resources with the aim to empower niches & make them more competitive	More diverse network (involving women, NGOs, etc); A new impact investment tool that crowds in investment into niche activities by traditional investors & crowd-outs investment in unsustainable systems
	Changing perceptions of landscape pressures	Facilitating processes that challenge individual & collective perceptions about landscape pressures of diverse groups of regime actors: policymakers, producers & businesses	Rise of social movements; Specific foresight activities with regime actors about whether & how digitisation contributes to climate action

Appendix C: Publicly-available supporting documents

Table C: Publicly-available supporting documents

USA	<ul style="list-style-type: none"> • https://www.npr.org/2023/04/20/1170987645/la-county-has-a-new-tool-thats-helping-trap-junk-before-it-flows-into-the-ocean
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	<ul style="list-style-type: none"> ● https://ktla.com/morning-news/earth-month-2023-the-innovative-trash-Interceptor/ ● https://www.latimes.com/california/story/2023-03-21/ballona-creek-trash-Interceptor-pacific-garbage-storm-runoff ● https://www.latimes.com/california/story/2023-01-04/waste-capture-system-protecting-pacific-from-l-a-runoff-faces-test-in-storm ● https://edition.cnn.com/videos/tv/2022/11/03/boyan-slat-Interceptor-la-plastic-trash-c2e-spc-intl.cnn ● https://www.pbs.org/newshour/show/teamseas-uses-youtube-to-tackle-the-global-plastic-problem ● https://ballonaInterceptor.lacounty.gov/
Malaysia	<ul style="list-style-type: none"> ● WHAT HAPPENS TO THE EXTRACTED RIVER WASTE?: https://theoceancleanup.com/updates/what-happens-to-the-extracted-river-waste/ ● Instagram post by Anwar Ibrahim: https://www.instagram.com/p/CsA3h3sgud1/ ● SMG Website: https://www.selangormaritimegateway.com/interceptor/ ● New life for Klang River: https://www.selangormaritimegateway.com/new-life-for-klang-river/ ● LLSB garners top prize for SMG efforts: https://www.selangormaritimegateway.com/llsb-garners-top-prize-for-smg-efforts/ ● #sayno2plastic: Ramadan Bazaar Encourages Own Containers to Reduce Plastic Waste: https://www.selangormaritimegateway.com/sayno2plastic-ramadan-bazaar-encourages-own-containers-to-reduce-plastic-waste/ ● SMG Brings Klang River Festival and Kabut In The Park To Taman Awam Pangkalan Batu: https://www.selangormaritimegateway.com/smg-brings-klang-river-festival-and-kabut-in-the-park-to-taman-awam-pangkalan-batu/
Jamaica	<ul style="list-style-type: none"> ● Installing Interceptor Barriers in Jamaica: https://www.youtube.com/watch?v=muFlbOPkWXg ● In Search for Solutions: Pollution in Jamaica’s Waterways: https://www.youtube.com/watch?v=ZFuG9E5BRIo ● JAMAICAN SPARKLE ON LOCATION FROM KINGSTON HARBOUR: https://theoceancleanup.com/podcasts/jamaican-sparkle-on-location-from-kingston-harbour/ ● EXPANDING THE INTERCEPTOR FAMILY: https://theoceancleanup.com/updates/expanding-the-interceptor-family/ ● THE OCEAN CLEANUP IS AWARDED \$1 MILLION TO COMBAT JAMAICA’S HIGHEST POLLUTING WATERWAY: https://theoceancleanup.com/updates/the-ocean-cleanup-is-awarded-1-million-to-combat-jamaicas-highest-polluting-waterway/ ● Mayor Lauds Gully Clean Up Project In Kingston: https://www.cvmtv.com/news/mayor-lauds-gully-clean-up-project-in-kingston/ ● Tivoli Gully gets interceptor to trap waste entering Kgn Harbour: https://jamaica-gleaner.com/article/lead-stories/20221217/tivoli-gully-gets-interceptor-trap-waste-entering-kgn-harbour
DR	<ul style="list-style-type: none"> ● CONSTANT IMPROVEMENT PASSING THE TORCH:

	<p>https://theoceancleanup.com/podcasts/constant-improvement-passing-the-torch/</p> <ul style="list-style-type: none">● BUILDING BRIDGES PLANET-SIZED PROBLEMS: https://theoceancleanup.com/podcasts/building-bridges-planet-sized-problems/● INTERCEPTOR 004: THE FIRST IN THE CARIBBEAN: https://theoceancleanup.com/updates/interceptor-004-the-first-in-the-carribean/● New Innovation Alliance Calls For Pragmatic Global Plastics Treaty: https://www.forbes.com/sites/jamiehailstone/2023/05/15/new-innovation-alliance-calls-for-pragmatic-global-plastics-treaty/?sh=81e31f374636
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Appendix D: The Ocean Cleanup's Interceptor solutions

INTERCEPTOR ORIGINAL

The Interceptor Original is our first river cleanup technology. The Interceptor Original is a high-tech solution with solar-powered mechanics, smart processing, and connectivity for easy performance tracking. It is designed for series production, and in December 2020, we entered a partnership with Konecranes to begin manufacturing for more locations. Due to its autonomous and large cleaning capacity, this is the primary technology we evaluate for feasibility in any new river we plan to tackle. We currently have deployed this technology in five locations: Indonesia, Malaysia, the Dominican Republic, Vietnam, USA (California). To learn more, visit our Interceptor Original page:



Boyan Slat and Interceptor 004 in the Dominican Republic

Figure D.1: Description and image of the Interceptor Original. The USA, Malaysia, and DR EPEs all deploy variations of this.



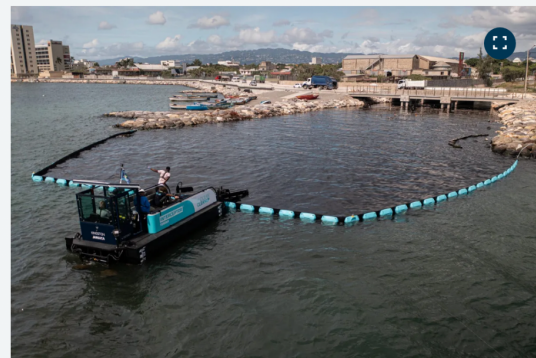
Kingston Harbour, Jamaica, Barnes Gully barrier

INTERCEPTOR BARRIER

The Interceptor Barrier is a solution that consists of a standalone floating barrier anchored in a U-shape around the mouth of a small river. This intercepts the trash and buffers it until it is removed from the water. The design builds on our experience from our existing Interceptor deployments. In fact, it is a variation of the barrier we use to concentrate trash toward the mouth of a standard Interceptor. The main difference is that, in this case, most of the barrier is permeable and is thereby optimized to efficiently buffer trash in the water.

INTERCEPTOR TENDER

The Interceptor Tender was developed to work alongside our Interceptor Barriers. This small powered barge uses a conveyor belt to scoop up the trash from a barrier and offload it into a dumpster onshore. While the Interceptor Barrier is a tool to intercept trash, it's not capable of extracting and offloading on its own. This is where the Interceptor Tender comes in. This mobile extraction and offloading unit – developed in collaboration with Berky GmbH – is capable of servicing multiple barriers, and we expect to see multiple Interceptor Barrier deployments in close proximity to others. This means that the cost of extraction/offloading equipment is shared over multiple Interceptor sites.



1/2 Kingston Harbour, Jamaica, Barnes Gully barrier and tender

Figure D.2: Descriptions and images of the Interceptor Barrier and Tender. The Jamaica programme deploys these solutions.